Chemical Engineering

AUGUST 1954

HOW TO WIN YOUR
Workers' Loyalty
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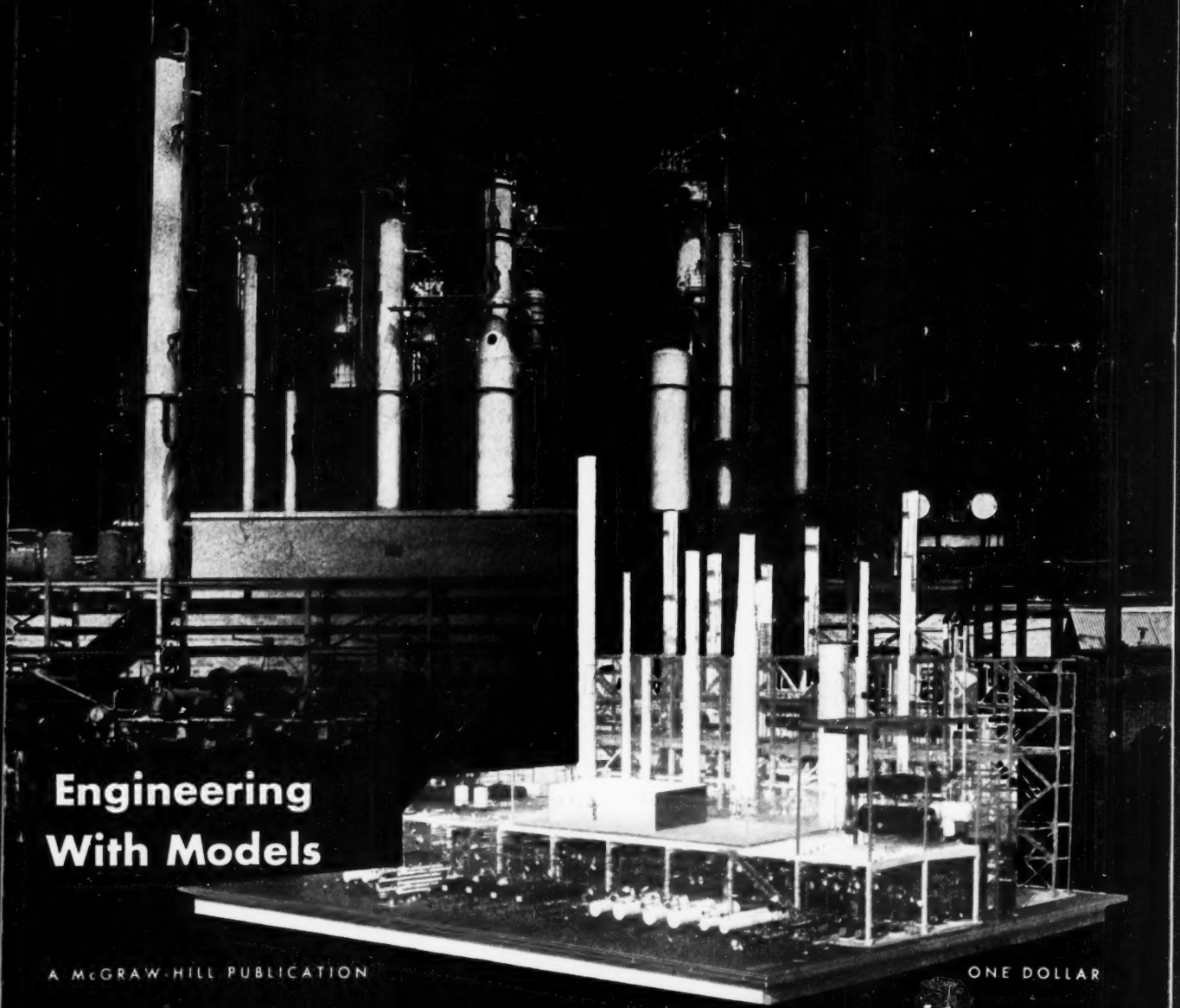

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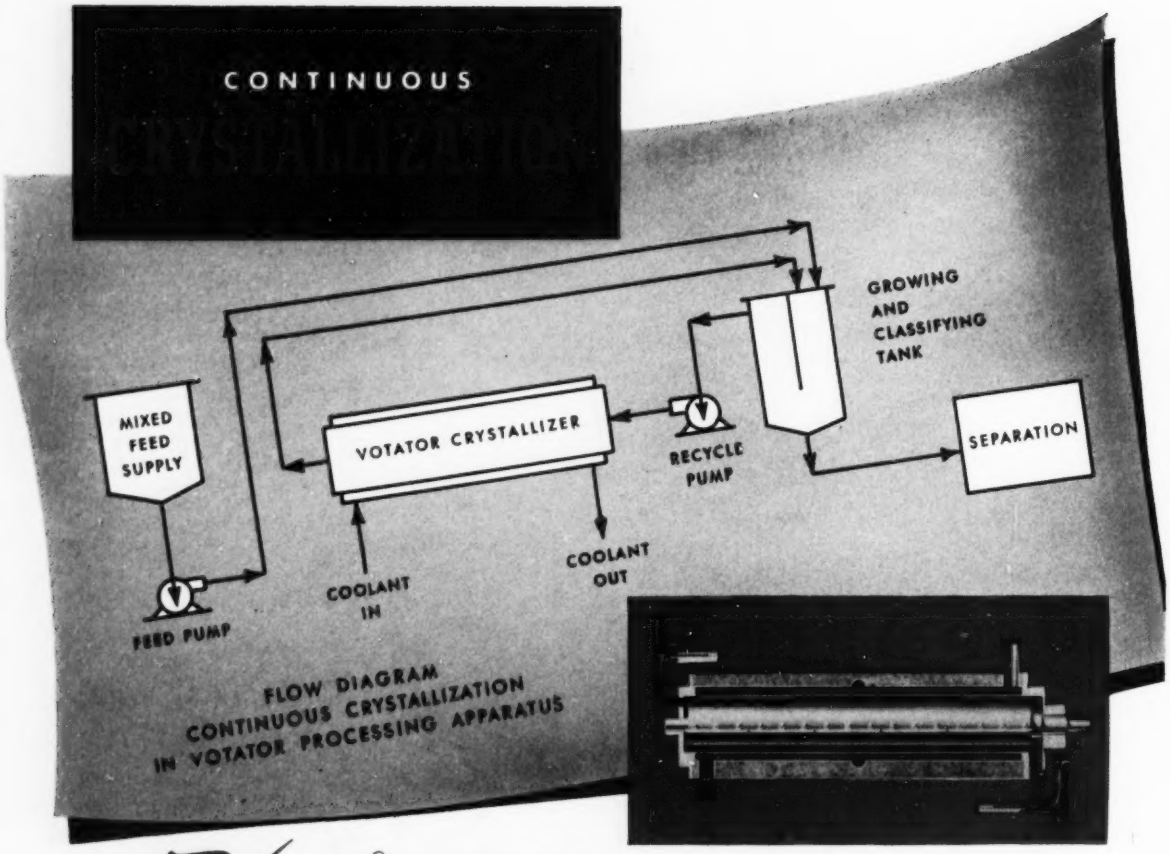

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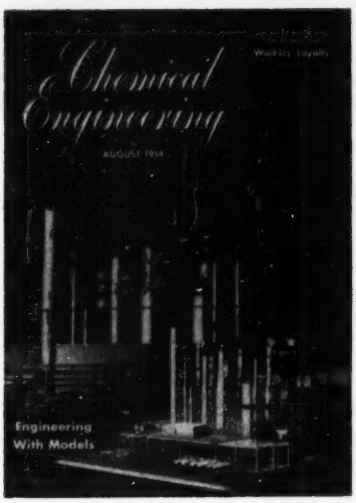
JOHN R. CALLAHAM, EDITOR



. . . Models can save you time and money on research, design and construction.

For design, construction and training, scale models can save you plenty of precious time and money. And for research and development, test or "operating" models are invaluable engineering tools.

In this issue Engineers Bowen and Murphy bring you a special 15-page report on these models and what they can do for the chemical engineer. (p. 175)

Shortcut to heat exchanger design.

Here's another of those popular Gilmour series on tricks you can use to speed up the designing of heat exchangers. This month's article—seventh and last in the series—covers reboilers. (p. 199)

Tips on how to grind to shape.

Fred Bond passes along his tested tips on how to measure particle shapes and how to control particle shape and size in grind-

Please turn page

Distillation Refresher

Next month we'll bring you something special you've been asking for: A roundup "refresher" on distillation.

This will be a single 20-page report rather than a series of articles. It has been prepared with the "refresher" slant very much in mind although considerable material of an advanced nature will be included.

Next month's report will deal with the principles and practice of conventional distillation systems. A later report will take up azeotropic and extractive distillation.

First part of our September report will be a discussion of vapor-liquid equilibrium relationships. This will be followed by a roundup of fractionation theory which will include a practical review of calculation methods. Another section will deal with equipment design and performance.

We're sure you'll find this special report on distillation useful and of practical value in your job. It's another "refresher" you'll certainly want to save!—JRC

GUIDED TOUR

ing operations. They're backed up with engineering data. (p. 195)

Preventive maintenance pros & cons.

Too many engineers are prone to wait for a breakdown before they think of maintenance. But planned preventive maintenance can often save headaches as well as money. Here're the reasons why. (p. 194)

Brush up on reaction kinetics.

Tom Corrigan starts his "refresher" on the kinetics of homogeneous reactions. This month he covers types of reactions, mass action, order of a reaction and how to determine it, reaction mechanisms. (p. 208)

Do you know how to win loyalty?

You're in for a tough time if you don't. For getting—and keeping—loyalty is a leader's first job. Here are tips on how it's done. Also: 9 tested ways to lost your workers' respect—damned fast! (p. 224)

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CHEMICAL ENGINEERING
August 1954 Vol. 61—No. 8

Chemical Engineering (with Chemical & Metallurgical Engineering) is published monthly by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. Publication Office: 99-129 North Broadway, Albany 1, N. Y.

▶**Executive, Editorial and Advertising:** 330 West 42nd St., New York 36, N. Y. Donald C. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Executive Vice President, Publications Division; Ralph B. Smith, Vice President and Editorial Director; Nelson Bond, Vice President and Director of Advertising; J. E. Blackburn, Jr., Vice President and Director of Circulation.

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▶**Subscriptions:** Write to Chemical Engineering—Subscription Service, 99-129 North Broadway, Albany 1, N. Y., or 330 West 42nd St., New York 36, N. Y. Allow one month for change of address. Please show position and company connection on all subscription orders.

Single copies $1 in U. S., Possessions and Canada; $2 in all other countries. U. S. and possessions, $3 per year, $4 for two years, $5 for three years; Canada, $4 per year, $6 for two years, $8 for three years; other Western Hemisphere and the Philippines, $15 per year, $25 for two years, $30 for three years; all other countries, $20 per year, $30 for two years, $40 for three years.

Entered as second-class matter Sept. 3, 1936 at Post Office at Albany, N. Y., under act of March 3, 1879. Printed in U. S. A.

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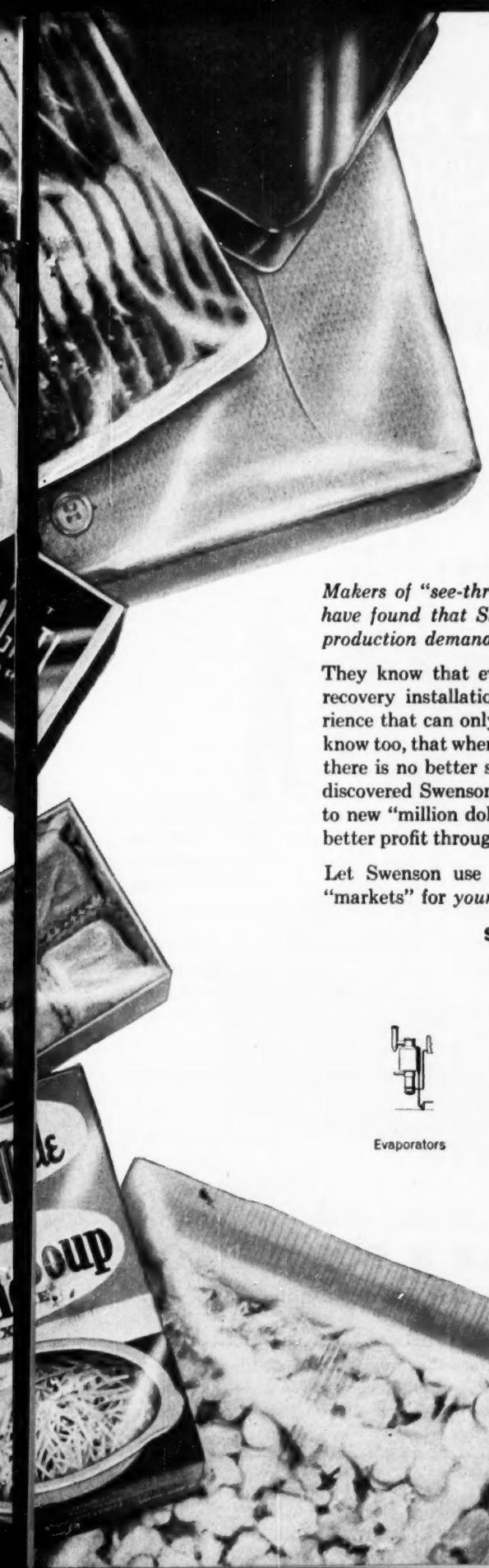

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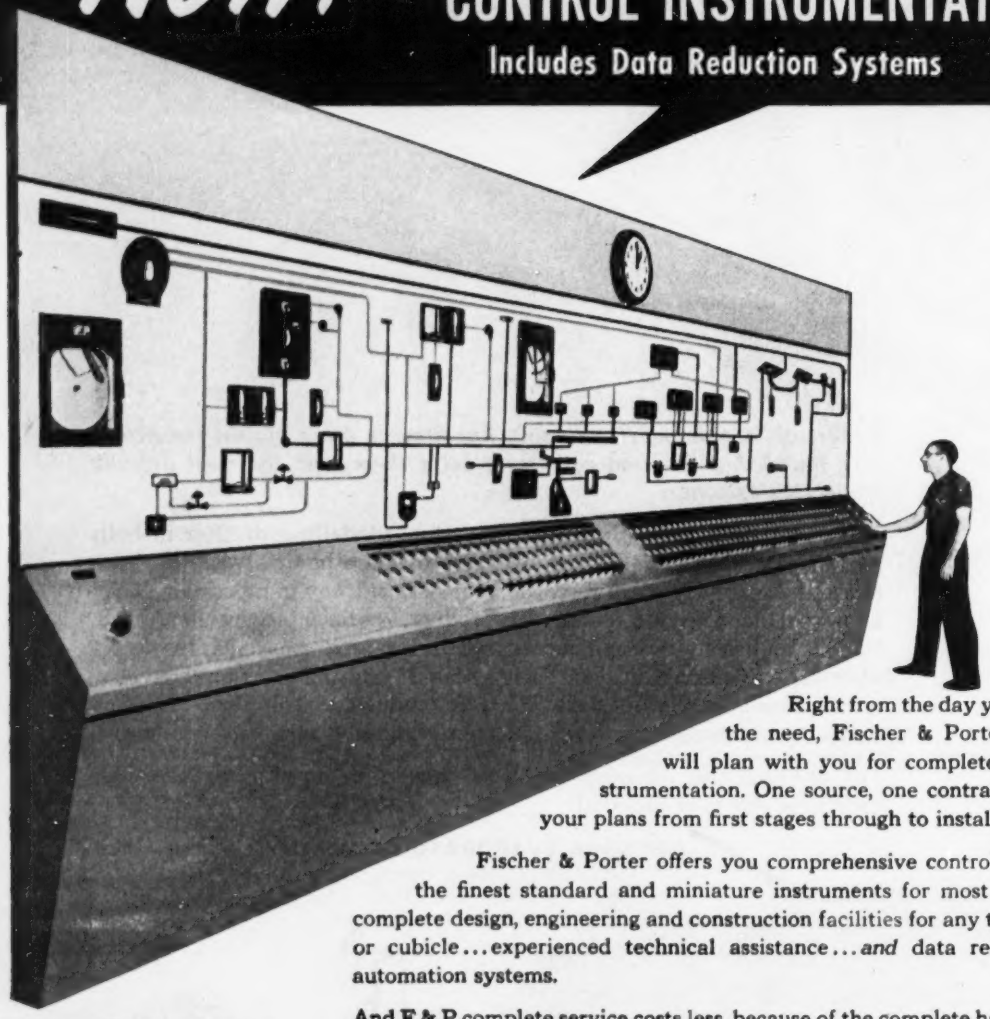

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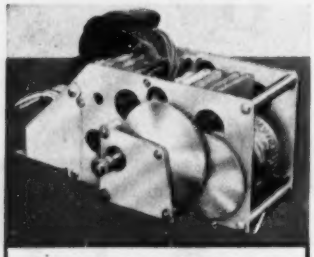

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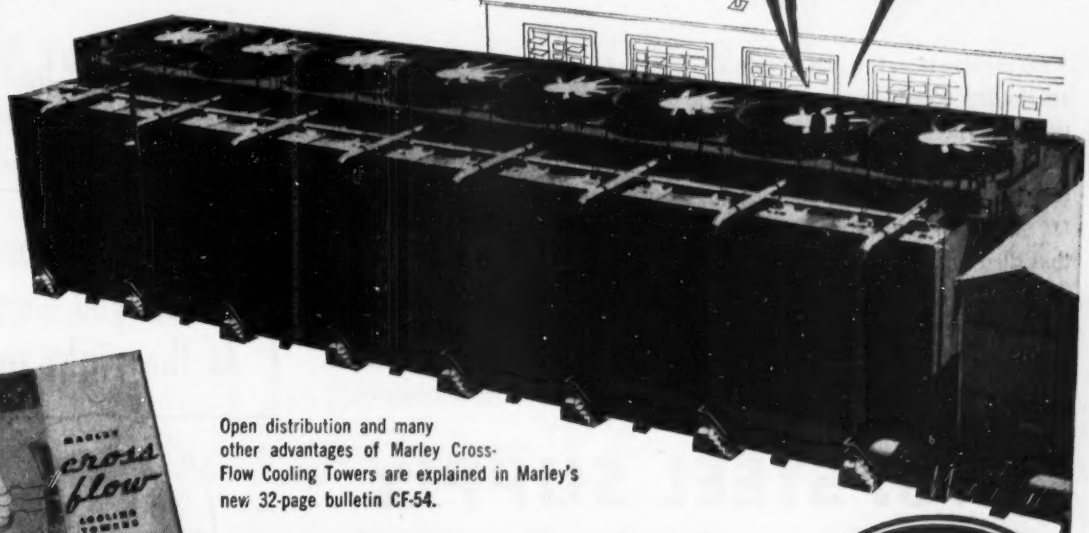

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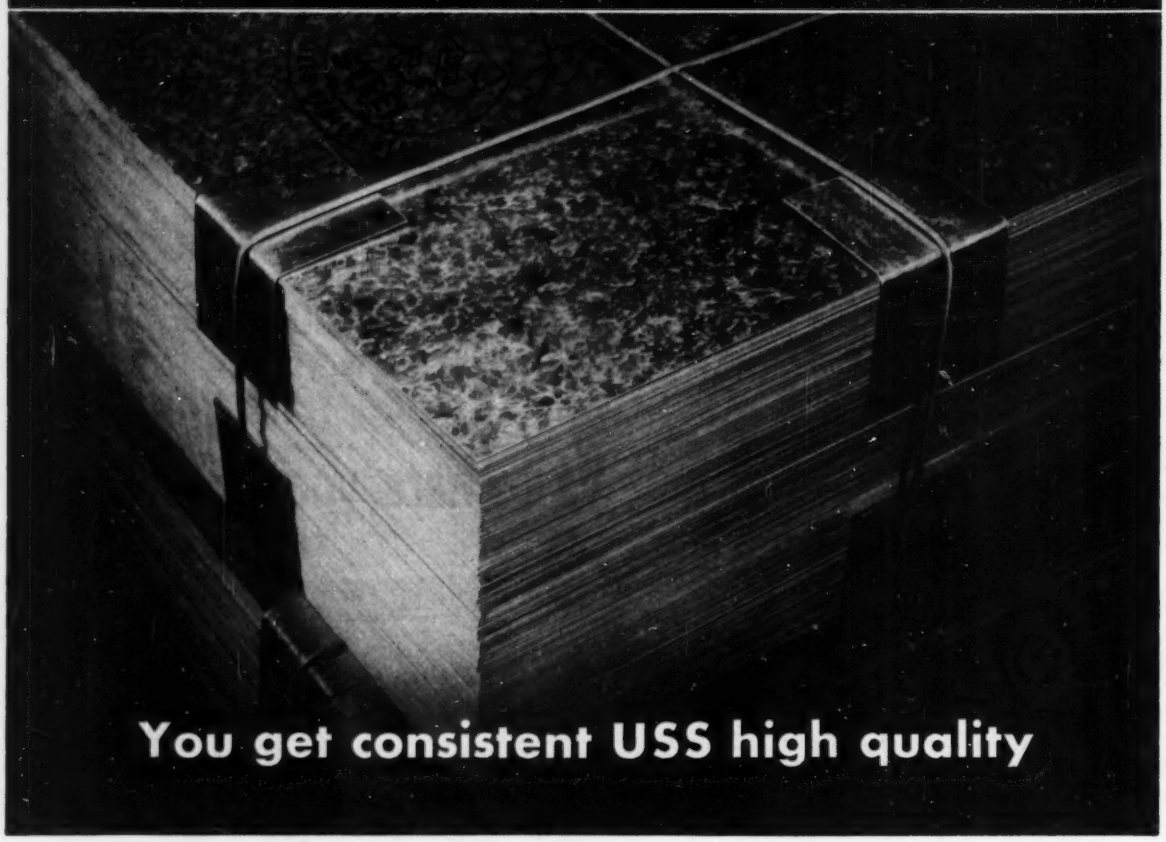

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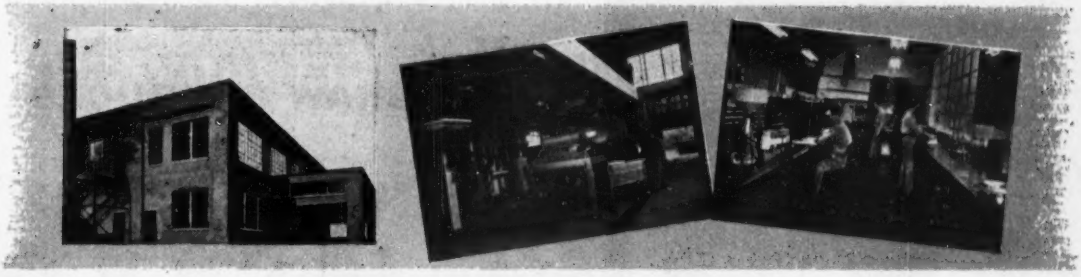

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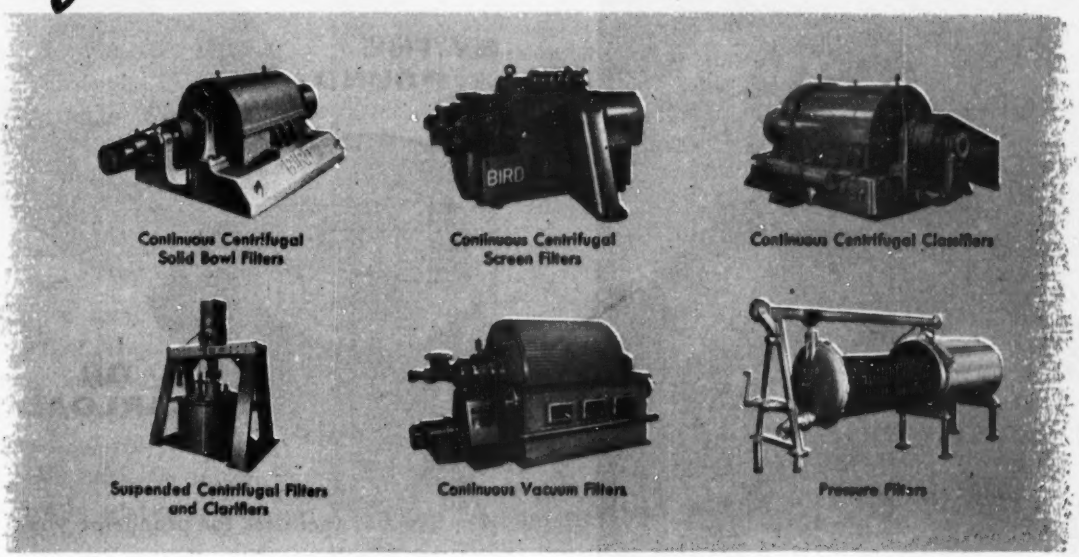

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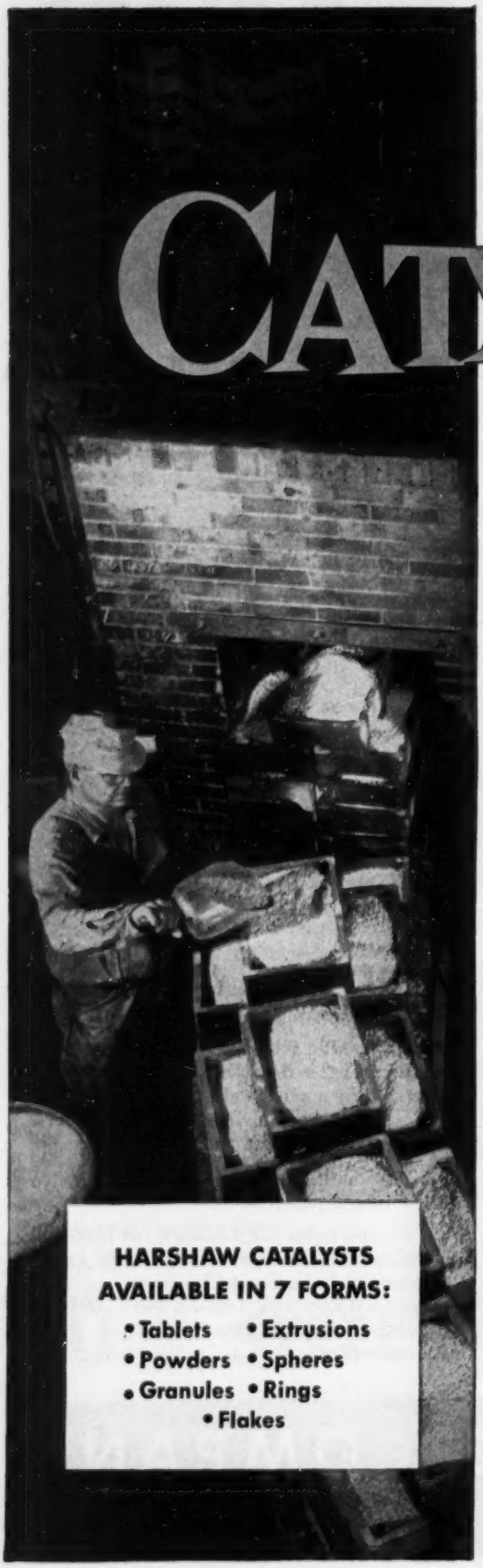

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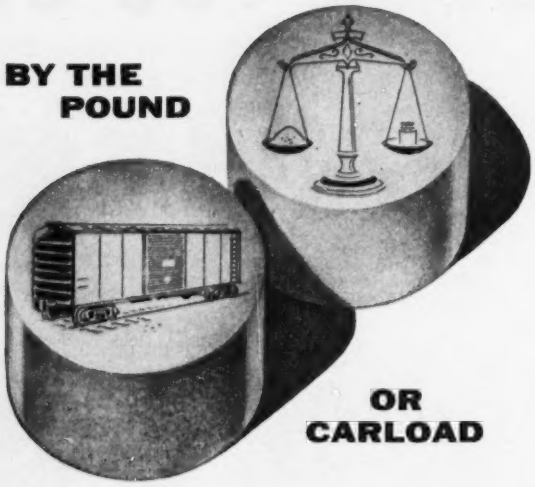

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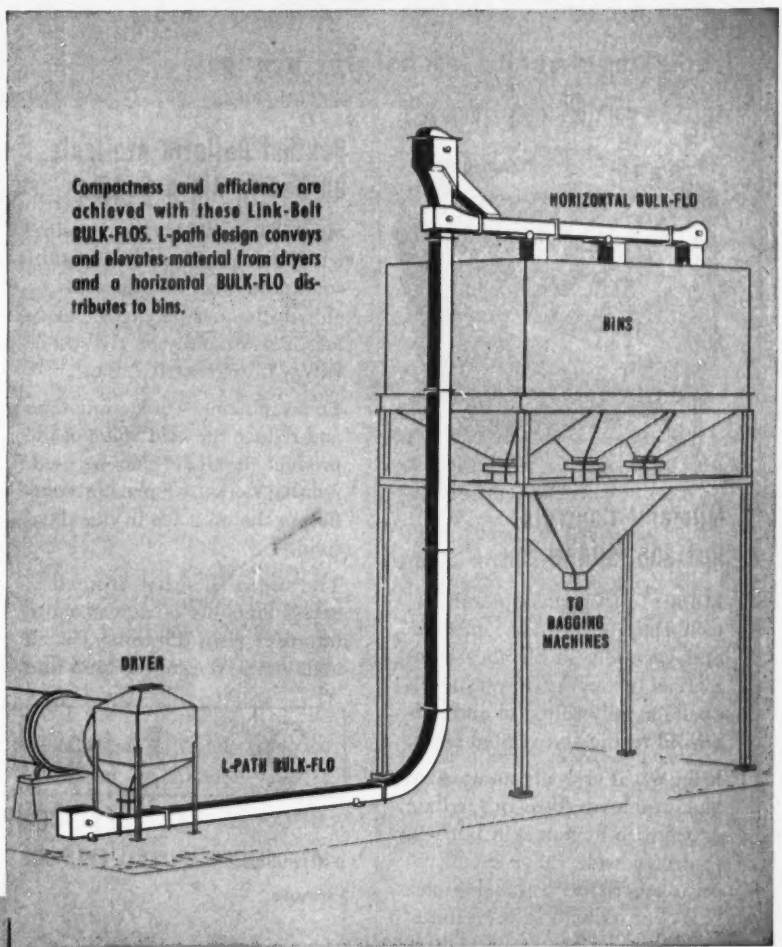
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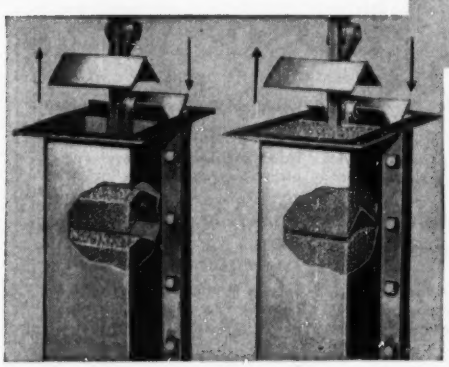

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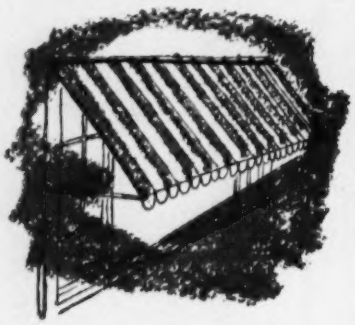

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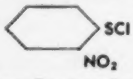
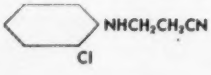
Formula:		
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Appearance and Color:	Yellow crystals	Liquid, colorless to red upon aging
Crystallization Point:	73-74° C.	
Nature of Impurities:	Traces of HCl, o-nitrophenyl disulfide, and o-nitrochlorobenzene	Traces of o-chloroaniline and o-chloroacetanilide
Odor:	Slightly irritating	Faint odor of aniline
Stability:	Decomposes explosively at 170° C.	Stable
Solubility:	Soluble in benzene, acetic acid, and chloroform; slightly soluble in ether and carbon tetrachloride.	Soluble in ethanol, ether, acetone, benzene and chloroform. Insoluble in water, hexane.
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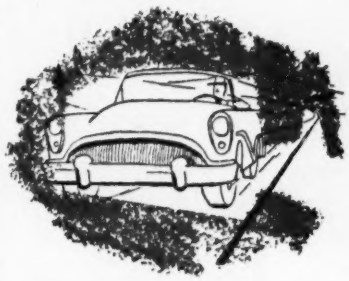
Laboratory quantities available to qualified chemists.

other illustrations, this new booklet thoroughly covers such topics as handling, storing, transferring, and unloading. Send for your copy now!



Aroclors Make Good E. P. Lubricant Base

To prevent seizure or scoring, try adding Aroclors,* Monsanto's chlorinated phenyls and biphenyls, to your lubricating oil. You'll get increased protection with no loss in viscosity.

Acting as an extreme pressure lubricant base, Aroclors 1248 and 1254 possess the following advantages:

1. Stability . . . even at high temperatures you have no worries about separation of components or appreciable changes in physical or chemical properties.

2. Nonvolatile . . . will not vaporize and pass out of lubricant.

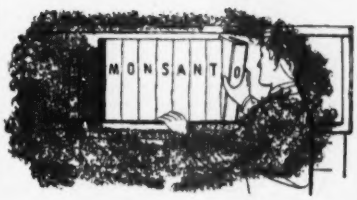
3. Nonoxidizing . . . won't thicken.

4. Other advantages . . . Aroclors are noncorrosive toward metal surfaces. They also have good compatibility and will not abrade machined surfaces.

Other uses for the Aroclor family include their application as:

- plasticizers in specialty lacquers, adhesives and vinyls
- ingredients in E. P. Lubricants
- ingredients in high styrene-butadiene stucco finishes
- an ingredient in chlorinated rubber coatings

For information send in the coupon.



from the MONSANTO BOOKSHELF

*Santicizer** *141* . . . a completely revised bulletin has been written on this Monsanto plasticizer summarizing all important information. Included in the bulletin are sections on chemical and physical properties, specifications, resin compatibility and performance characteristics. Santicizer 141 offers flame retardency, non-toxicity processability and low temperature flexability.

The concluding parts of the booklet review the effects of Santicizer in plastisols and list some recommended formulations. A coupon will bring your copy by return mail.

Fumaric Acid . . . a new bulletin just issued describes the use of fumaric acid in coatings and polyester resins. The bulletin is primarily for the synthetic resin trade. It covers such subjects as chemical reactions, fumaric acid in drying oils, in tall oil varnishes, in steam-set inks, and in polyester resins. It also gives details on experimental research with this acid in alkyd resins.

New Uses for Phosphorus Chloride Compounds

Phosphorus trichloride and phosphorus oxychloride from Monsanto possess a high degree of reactivity and can be used in a wide number of applications.

Phosphorus oxychloride can be used to make phosphate esters which are finding new uses in the petroleum industry.

The oxychloride is also useful in preparing certain pharmaceuticals and dye intermediates.

The second compound, phosphorus trichloride, is even more versatile than oxychloride. Phosphorus trichloride can be used to make phosphite esters, petroleum additives, and insecticides. It also may be used as a catalyst or chlorine carrier in the chlorination of many organic compounds. For more information on these two products send in the coupon today.

*Reg. U. S. Pat. Off.

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Please send information on: Phosphorus Oxychloride and Trichloride.

Please send:
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- ☐ Benthal Bulletin O-103
- ☐ Phenol Handling Booklet
- ☐ o-Nitrobenzenesulfenyl Chloride Data Sheet
- ☐ beta-(o-Chloroanilino) Propionitrile Data Sheet
- ☐ Aroclor Bulletin P-128
- ☐ Santicizer 141 Bulletin O-89
- ☐ Fumaric Acid Bulletin O-115

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There's more to instrumentation than instruments

Instruments can do wonders, if they're given the chance. But some one has to put them to work in the most effective way. And that's where Honeywell Application Engineering steps in.

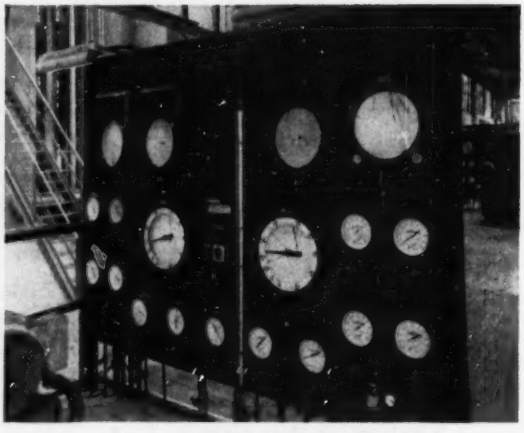
This service is one of the most important plus values you get in Honeywell instrumentation. It's a teamwork job. And every member of the team is an expert in his own field. Engineering begins right in your own plant, where a Honeywell field man digs out the vital facts about your process. He sits down with your engineers, production men and instrument technicians . . . and finds out everything he needs to know about what needs to be measured or controlled, to what accuracy, and under what conditions.

Then the problem goes to Honeywell's Application Engineering staff. Here's where you'll find groups of instrumentation specialists for every major industry. One group, for example, is devoted to the control problems of the metalworking industry. Another handles ceramic applications . . . another chemical . . . until together they cover the whole gamut of modern processes. These men know their specific field from years of first-hand experience. They're thoroughly familiar with the techniques of processing and the ways that instrumentation should be applied.

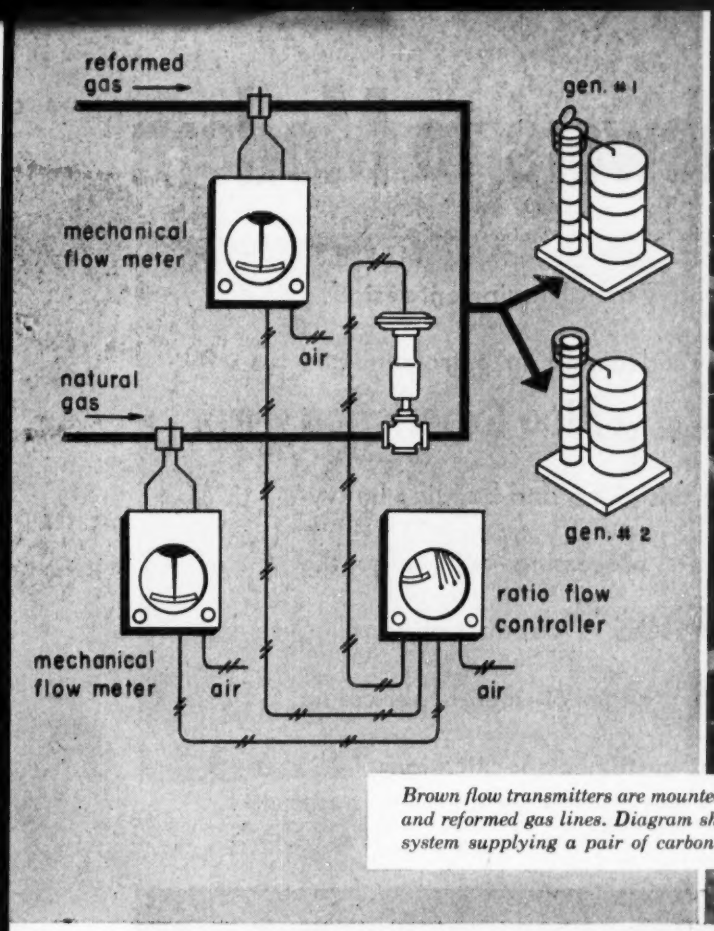
Honeywell Application Engineers develop detailed recommendations for the complete installation. They determine the most effective instruments, primary elements, types of control and valves for every phase of measurement and control. They add switches, signals, interlocks and other accessories which their experience indicates are needed in the interest of safety and convenience. Then they combine all components into a complete system—whether it involves a single instrument or a whole panel—that is designed for peak production efficiency, simple maintenance, and greatest convenience to operators.

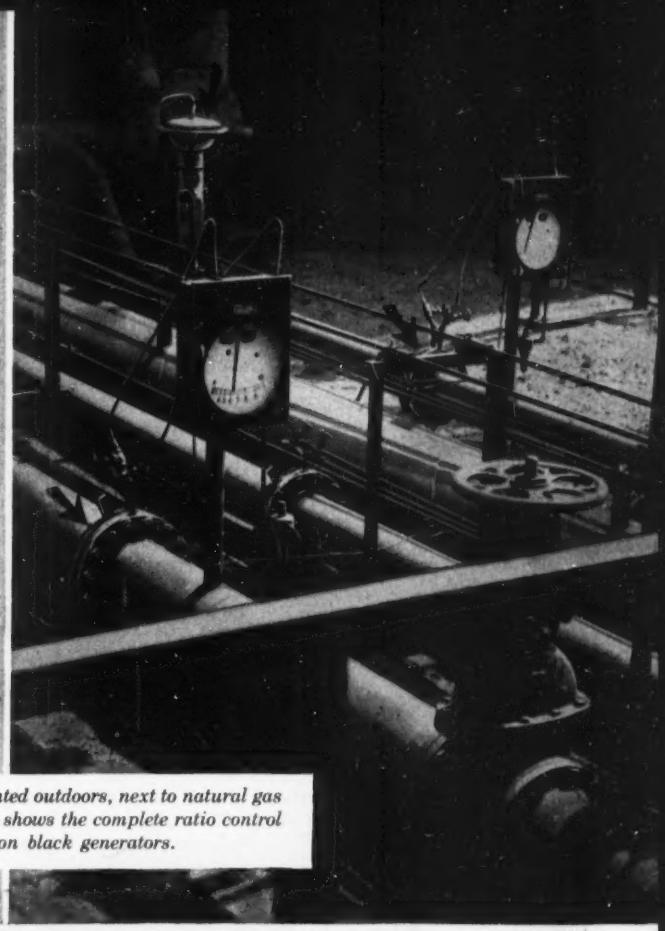
This service saves time by doing engineering work that would tie up your own staff for many hours. And it pays off in assuring the excellent performance of which Honeywell instruments are capable.

Ratio controller regulates critical gas mixtures in



Control panel for carbon black generators includes (in upper right corner) Brown ratio flow controller . . . along with ***ElectroniK*** *instruments for checking temperatures inside the generators.*





Brown flow transmitters are mounted outdoors, next to natural gas and reformed gas lines. Diagram shows the complete ratio control system supplying a pair of carbon black generators.

carbon black production

GOT a process in which two different gases must be supplied in exact proportion? Godfrey L. Cabot, Inc., were faced with a problem like this in their thermal carbon black plant near Franklin, Louisiana. And the Brown flow control system that was developed for this job in cooperation with The Gas Machinery Company may give you some ideas for your own applications.

The Cabot process cracks carbon out of natural gas, in cyclic reactors or generators designed and built by The Gas Machinery Co. To produce various grades of black, the natural gas fed to the generators must be diluted with reformed gas. A Brown two-pen ratio flow controller, working with two Brown mechanical flow meters, does the trick. The flow meters measure the flow in both the natural and reformed gas lines, and each transmits air pressure signals to actuate one of the ratio controller's pens. On the basis of these signals, the controller regulates a Honeywell diaphragm valve in the natural gas line, to maintain the required ratio of flows of natural gas and diluent.

This simple, rugged system provides excellent accuracy, to keep flow ratios at optimum values. It's versatile, too . . . can be readily set to allow feed of straight natural gas when coarse grades of carbon are required.

Many other types of flow instrumentation are available from Honeywell for the varied requirements of chemical processes. Your nearby Honeywell field engineer will be glad to discuss your specific applications . . . and he's as near as your phone.

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● **REFERENCE DATA:** Write for new Catalog 2320, "Flow Meters, Indicating, Recording, Integrating and Controlling."

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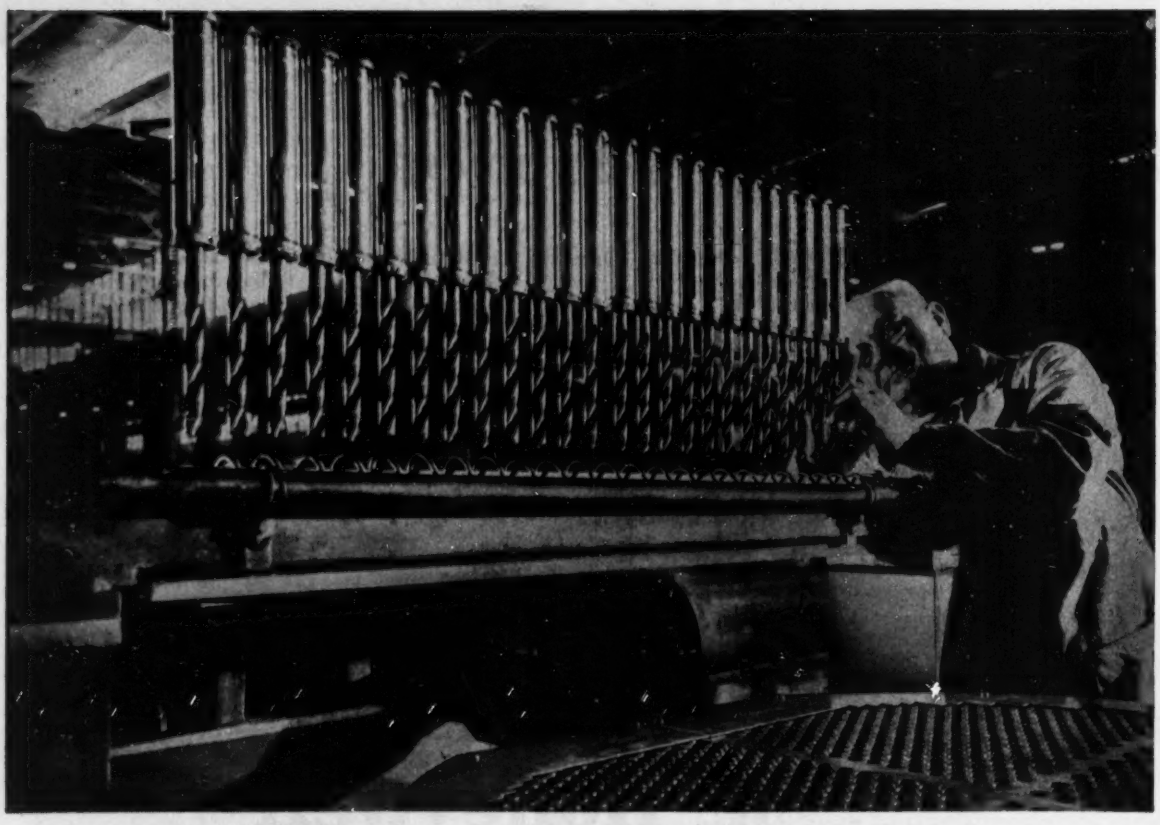
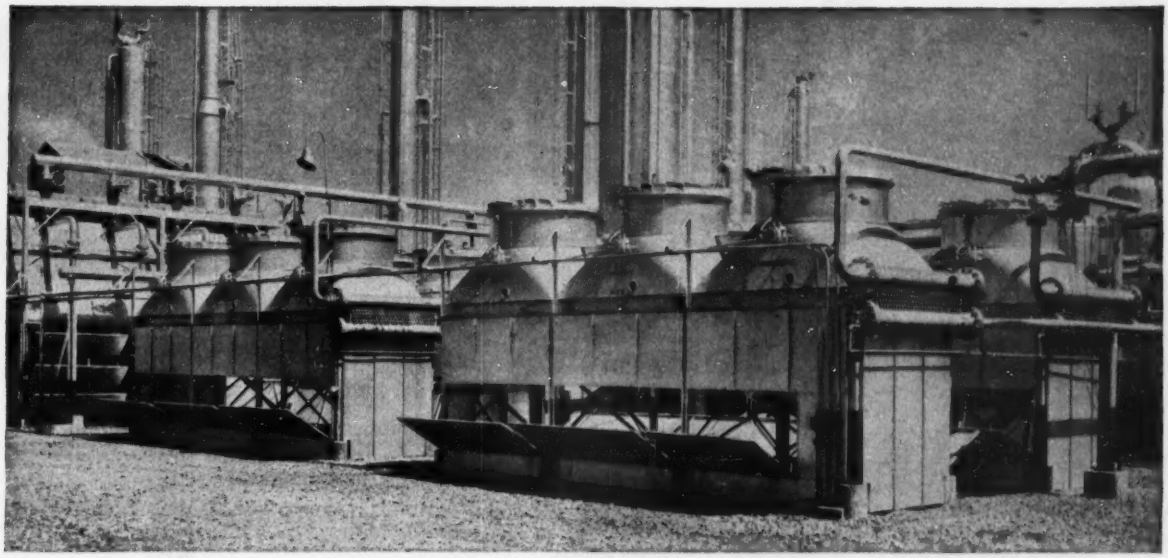
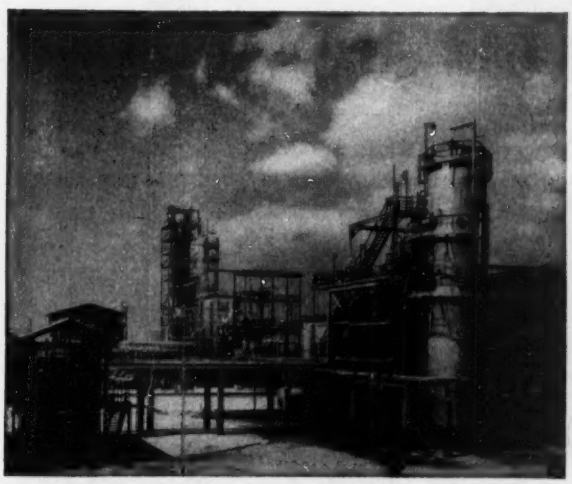


NEW 25 SPINDLE DRILLING MACHINE at Alco's Dunkirk plant typifies the special equipment that enables Alco to produce profit-building answers to almost any processing problem. Spindles take drills up to 1-in. in diameter, pierce steel tube-sheets and support plates up to 4-in. thick at optimum speed.

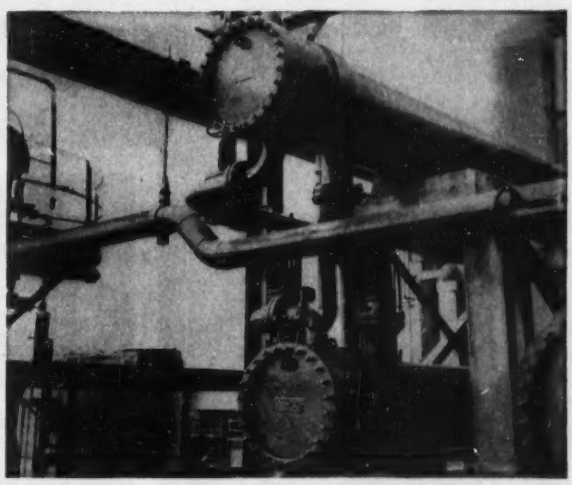
Processing problems



AIRCOOLERS solve the problem of efficient, economical heat dissipation in arid regions. Here, at a Wyoming gas plant, each of two batteries of two specially designed Alco units cools 125,500 lb per hr of lean solution (175 psi, 200 F) at a rate of 4,920,000 Btu per hr—a total of 251,000 lb and 9,840,000 Btu per hr.



AMONG THE MANY ALCO UNITS now in service at Shell Caribbean Petroleum Company's new refinery at Cardon, Venezuela, are the pressed oil flashtower and pressed oil stripper. With a daily capacity of 170,000 bbl, Cardon is the largest refinery on the South American continent.



SPECIAL MONEL CONDENSERS, fabricated by Alco for Atlantic Refining Company's Philadelphia plant, boost efficiency in the manufacture of "Ultrawet" synthetic detergent. Monel construction guards against corrosion by the dilute hydrochloric acid produced in the vapors.

As the first step toward profit-building answers to your own processing problems, contact your nearest Alco Products Sales Representative today. Offices in Dunkirk, New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa, and Beaumont.

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B&W Banded Bottles . . .

to store the

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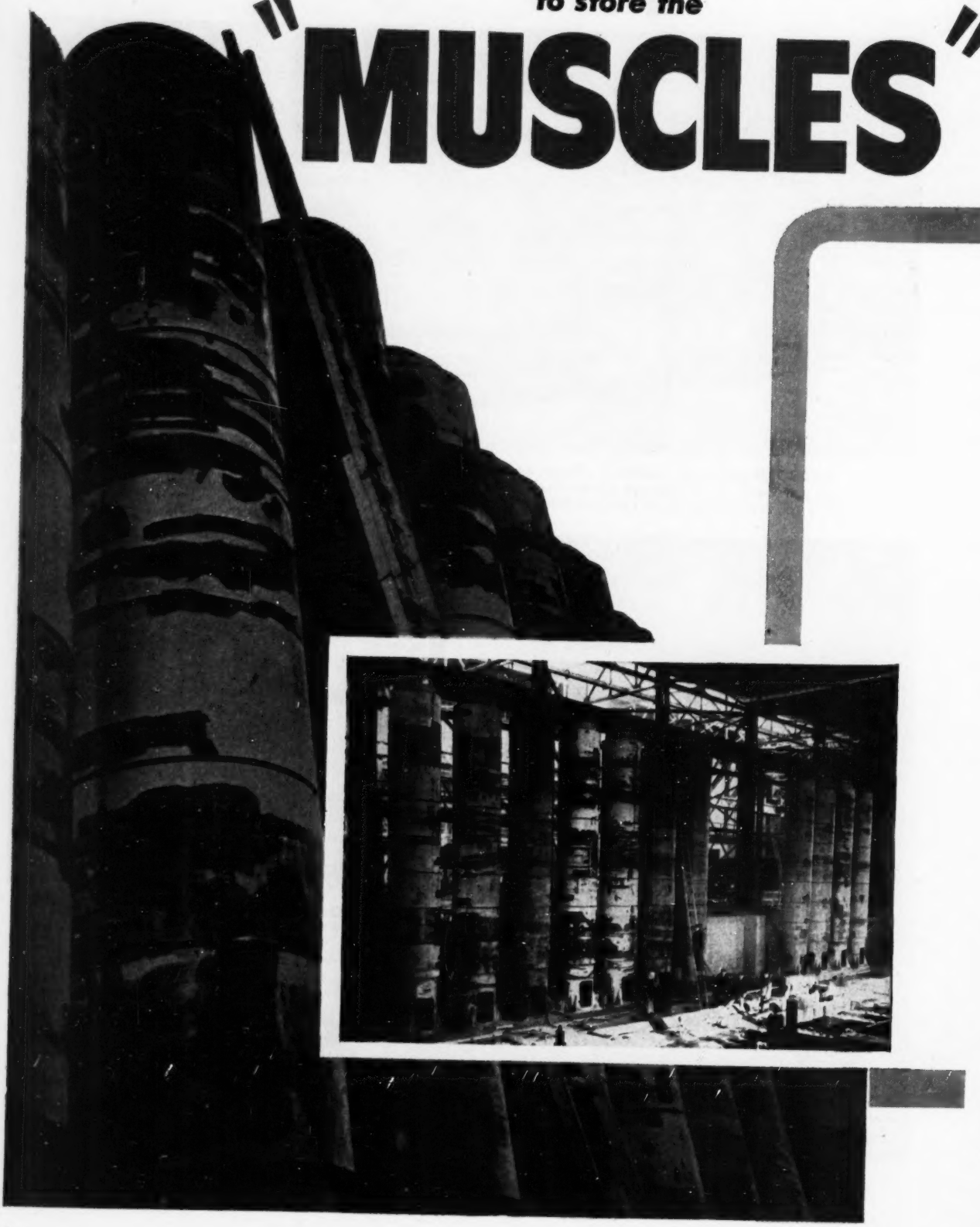
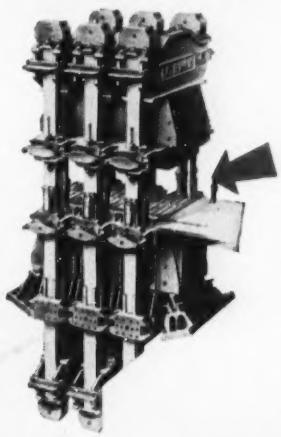


for the WORLD'S MIGHTIEST PRESS

Between strokes of this mammoth press, these seven huge B&W Accumulators will hold in check the tremendous hydraulic force —water at a pressure of 4500 psi—required to operate the largest, heaviest, most powerful production tool in the world. It is a 50,000-ton, ten-story-high, die-forging press built by Loewy-Hydropress, Inc., and now being erected at the Wyman-Gordon plant near Worcester, Massachusetts, for the United States Air Force. When completed it will be perhaps the most effective tool yet designed to aid democracy's defense. And alongside this unit, a 35,000-ton press—to be served by the four additional B&W Accumulator Bottles shown—is also being erected for the USAF.

For high pressure such as this — in the range between 2000 and 6000 psi—B&W Banded Pressure Vessels have a measurable advantage over conventionally constructed vessels. The inner shell—in this instance consisting of 4-inch-thick plate—is fabricated in accordance with ASME Code requirements to withstand longitudinal pressure loading. And to reinforce that shell circumferentially, a seven-inch-thick layer of steel bands is wrapped around it, enabling each accumulator to contain safely, the pressure of the hydraulic fluid.



As with these specific bottles, uncompromising care and the most advanced techniques go into the fabrication of every B&W Pressure Vessel. Each production step is performed on equipment designed specially for its job. Much of this equipment as well as many types of construction used, are original B&W developments.

Whatever your operations may be, if they require accumulators capable of withstanding working pressures somewhere between 500 and 6000 psi, with capacities ranging from 5 gallons to 10,000 gallons, it will pay you to get the facts about B&W Pressure Vessels. The Babcock & Wilcox Company, Process Equipment Dept., Barberton, Ohio.

BABCOCK & WILCOX

B-429

* *Sidney D. Kirkpatrick, Editorial Director of* CHEMICAL ENGINEERING

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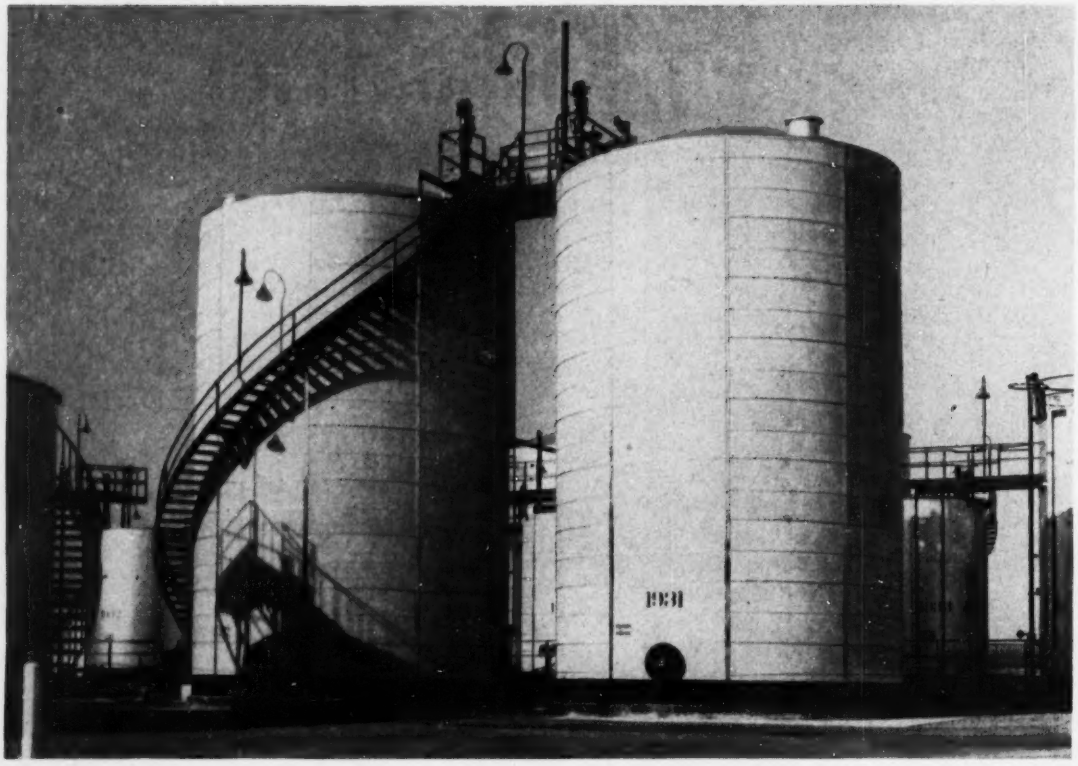
if CORROSION is the problem . . .



HORTON nickel clad tanks may be the answer

Whether you need nickel clad tanks, stainless clad or solid stainless . . . Chicago Bridge & Iron Company's expert design, fabrication and erection departments are experienced in solving problems involving all types of corrosion-resistant metals. With complete equipment at all four plants for stress-relieving and x-raying and facilities for pickling and painting fabricated materials by the Horton phosphoric acid process, solving tough problems and meeting exacting specifications is all in a day's work.

The nickel-clad tanks above are two of five we built for the Standard Oil Company of California's Richmond Refinery. They are 24-ft. in diam. by 36-ft. high.

When planning welded steel structures, corrosion-resistant or otherwise, write our nearest office for information, estimates or quotations. CB&I engineers will be happy to help you.

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Cleveland 15 . . . . . 2220 Midland Bldg.
Detroit 26 . . . . . 1503 Lafayette Bldg.
Houston 2 . . . . . 2103 C & I Life Bldg.
Los Angeles 17 . . 1505 General Petroleum Bldg.
New York 6 . . . . . 3318—165 Broadway Bldg.
Philadelphia 3 . . 1625—1700 Walnut St. Bldg.
Pittsburgh 19 . . . . . 3205 Alcoa Bldg.
Salt Lake City 4 . . . . 505 West 17th South St.
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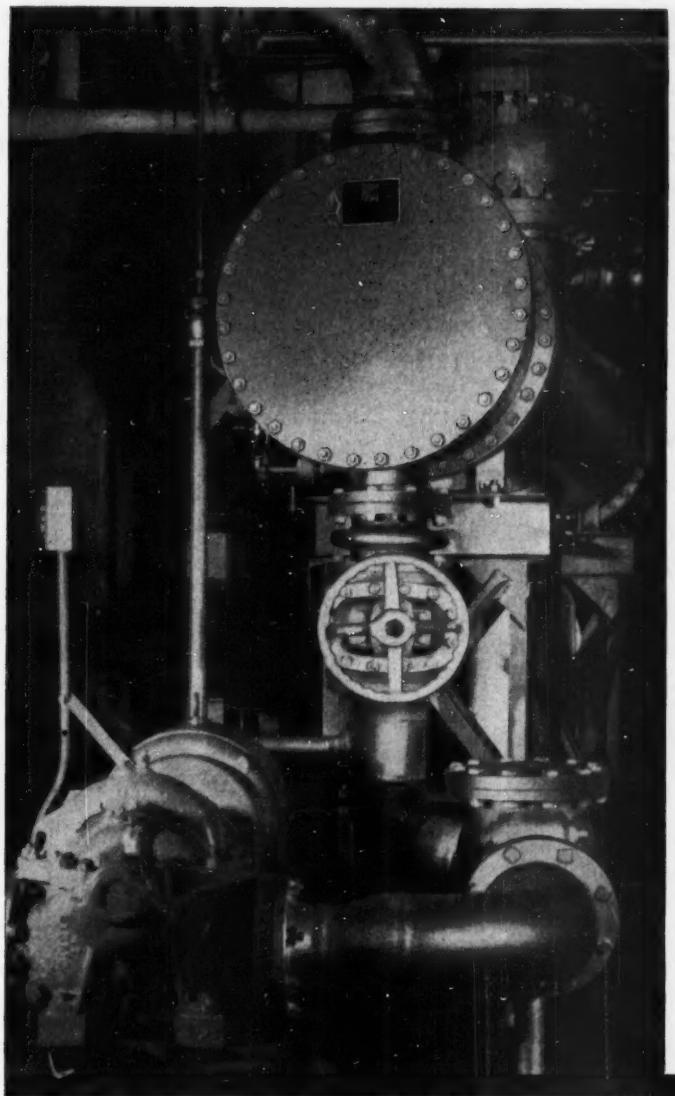

With a staff of 982 employees and care facilities for 3,016 patients, the Connecticut State Hospital, Middletown, Conn., is one of numerous institutions, public utilities, office buildings, refineries and other industries served by Ross Surface Condensers. Here, the Ross unit condenses the exhaust from a 500 kw turbine generator set, producing 26 in. Hg. vacuum.

Because it has engineered and built so many condensers: standardized, special and packaged units . . . because it has originated so many "firsts" in condenser design, the Kewanee-Ross organization is uniquely qualified to be of maximum service in planning, designing and fabricating surface condensers for your requirements.

Why not consider Kewanee-Ross in your next installation? Word from you will bring a Kewanee-Ross representative to your plant with valuable data on surface condensers and exchangers, whatever your requirements may be.

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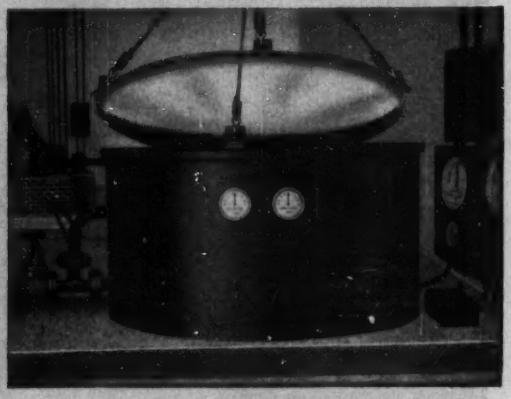
Pioneers in HOMOGENEOUS LEAD BONDING

First Again with a "NEW MECHANICAL"* Bonding Process

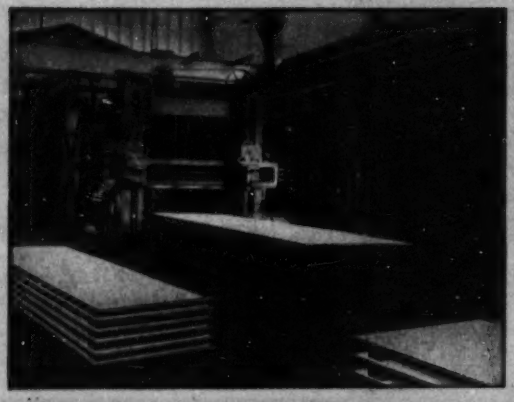
*Our newly developed "mechanical" process for applying **Homogeneous Lead Bondings** affords you a considerable saving in both delivery time and cost over the slower "hand-burning" method.

We suggest that you pay a visit to our plant and view this newly developed "Mechanical" cost-saving lead bonding process. Our Engineers are available for consultation without obligation. Your inquiries are solicited.

Homogeneous Lead Bondings are applied to any thickness of shell plates in the flat before shaping to your specifications. Plates as large as 10'-0" x 20'-0" are easily handled on our new unit, thus eliminating many unnecessary weld seams. Outlets and connections are Homogeneously Bonded regardless of size.



To insure uniform overall thickness of the Homogeneous Lead Bondings and eliminate the human errors occurring in other methods, lead is applied "oversize" to flat sheet plates and then planed to required thickness. In addition, this operation affords considerable savings in time over the general "Hand Scraping" method.



Dished Heads of all types and various irregular shaped pieces of equipment are Homogeneously Lead Bonded in our Special "MECHANICAL" Unit. Here again, considerable saving in time and cost is effected over the general method.

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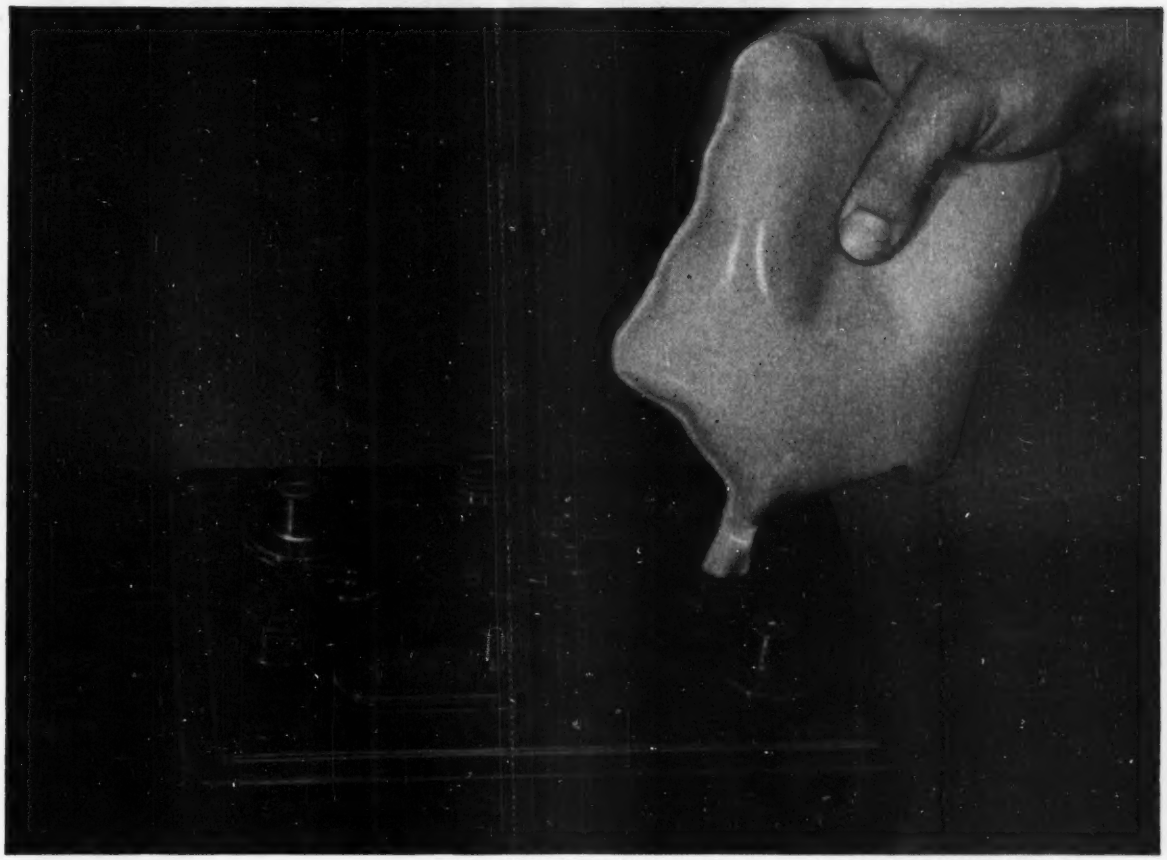

B. F. Goodrich Chemical Company does not make these containers. We supply the Geon resin only.

New Disposable Vinyl Container answers many packaging problems

WHEN your design work calls for improving an existing product, Geon materials often provide the answer—and economically too.

This flexible, disposable container—made from a Geon polyvinyl material—packages the electrolyte for dry-charged storage batteries. Costing less than conventional containers used for this purpose, the tough bag requires a minimum of shipping space and carries a printed sales message on its smooth surface. Its exceptional strength resists puncturing and tearing.

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Geon materials have many packaging uses—from film liners to drum coatings. We'll help you select the right material for your needs. For information, please write Dept. GE-8, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable

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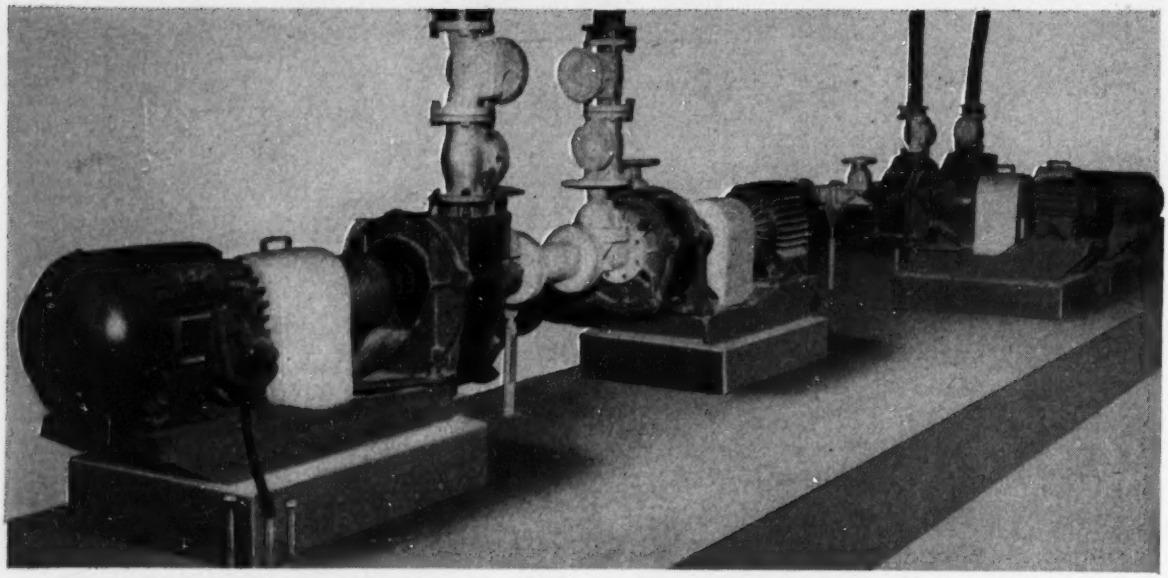

Are you looking for a centrifugal pump you can designate as "standard" *wherever* corrosion is a factor? Then you'll want to consider the combination of "Karbate" impervious graphite and efficient, service-tested designs which can bring you these advantages in two outstanding pumps:

- **Choice of frame or motor-mounted styles**
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- **Maximum interchangeability of parts**
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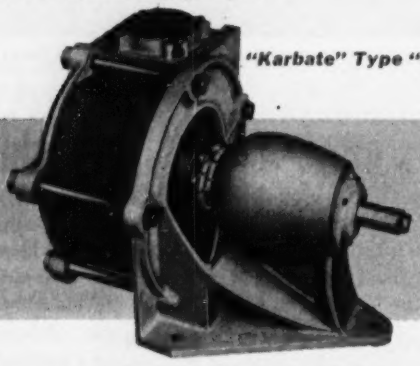
- **Strong, rugged, easily-maintained constructions**

"Karbate" Type "C" Centrifugal Pump



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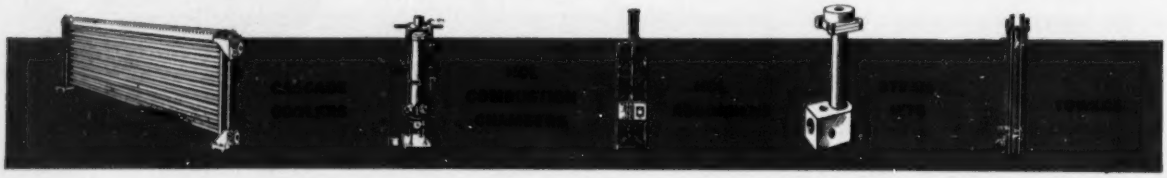
"Karbate" Type "F" Centrifugal Pump

A heavy duty model. Rugged, "Karbate" wet-end parts, including impeller and seal assembly, accessible without disturbing pump shaft, ball bearings or pump-to-driver alignment. Mechanical seal standard at no extra cost. Capacities to 1500 gpm, heads to 120 feet in three pump sizes – 2", 3" and 4" I.D. discharge openings.

Low cost, motor-mounted model with features of costly, frame-mounted pumps. Permanent pump and motor alignment. Internal-type, mechanical seal adjustable while pump is running, standard in all sizes at no extra cost. Capacities to 200 gpm, heads to 100 feet in two pump sizes – 1¼" and 2" I.D. discharge openings.



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IMPERVIOUS GRAPHITE PROCESS EQUIPMENT

"Karbate" Standard Heat Exchangers
Catalog Section S-6B40

"Karbate" "Series 90A" and "Series 310A"
Heat Exchangers — Catalog Section S-6740

● You can *standardize with complete economy* on National Carbon's extensive line of "Karbate" impervious graphite tube-and-shell-type heat exchangers. "Series 90A" and "Series 310A" "Karbate" exchangers are available *from stock* in single and multi-pass tube-side arrangements — tube lengths to 16 feet and surface areas up to 162 square feet per unit. "Karbate" standard heat exchangers, based on stock "Karbate" tube-bundle and cover constructions, provide surface areas up to *2300 square feet per unit* in 6, 9, 12, 14 and 16 feet tube lengths at unusually low first-costs. Choice of tube-pass and shell arrangements is virtually unlimited.

SEE FOR YOURSELF — properties, manufacture, applications! Learn how to do it!

. . . in these 16mm, full-color movies on "Karbate" impervious graphite equipment. Conveniently divided into "what is it" and "how to" sections — "MEETING THE CHALLENGE" and "BY WAY OF EXPERIENCE." History of the material, development, industrial applications . . . plus step-by-step installation and maintenance. WRITE — right now — for showing dates.

Descriptive Booklet Sent On Request

The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

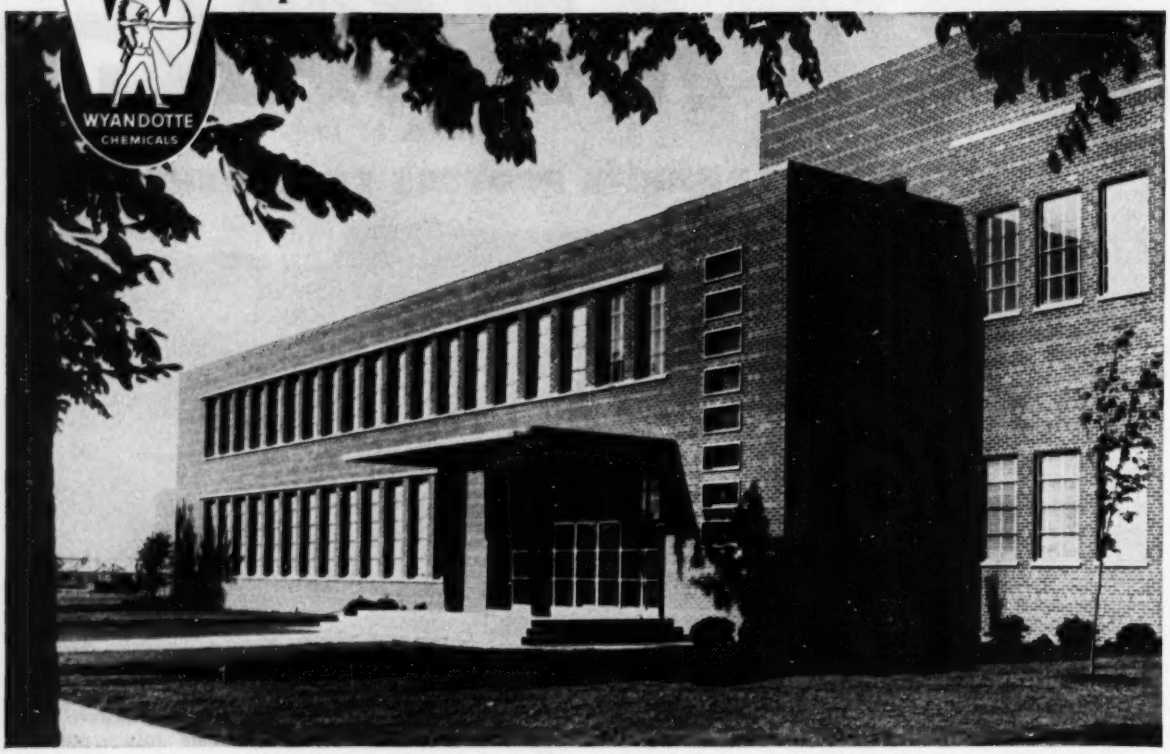
NATIONAL CARBON COMPANY

A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N.Y.

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

IN CANADA: Union Carbide Canada Limited, Toronto

Dependable Source for Chemical Raw Materials



Research is the cornerstone for growth and progress in the chemical industry. Here is part of Wyandotte's extensive new Research Center.

Wyandotte now offers 2 more high-purity Petro Chemicals . . .

Ethylene Glycol

$$\begin{array}{l} CH_2 \cdot OH \\ | \\ CH_2 \cdot OH \end{array}$$

Diethylene Glycol

$$O\begin{array}{l} CH_2 \cdot CH_2 \cdot OH \\ CH_2 \cdot CH_2 \cdot OH \end{array}$$

Why is Wyandotte adding industrial grades of glycols?

There are two reasons. One is to provide our customers who need them with purer grades of ethylene glycol and diethylene glycol. The second is to expand our markets into still wider fields.

What about the future of glycols?

We think the surface has been barely scratched. Every day, new uses are being found for these versatile petro chemicals. Ethylene glycol and diethylene glycol already play important roles in the processing and manufacture of cellophane,

synthetic fibers, synthetic rubber, explosives, paper, adhesives, resins and dyes. We believe the future of glycols and their related products is as unlimited as that of the chemical industry itself.

What is one example of the future for glycols?

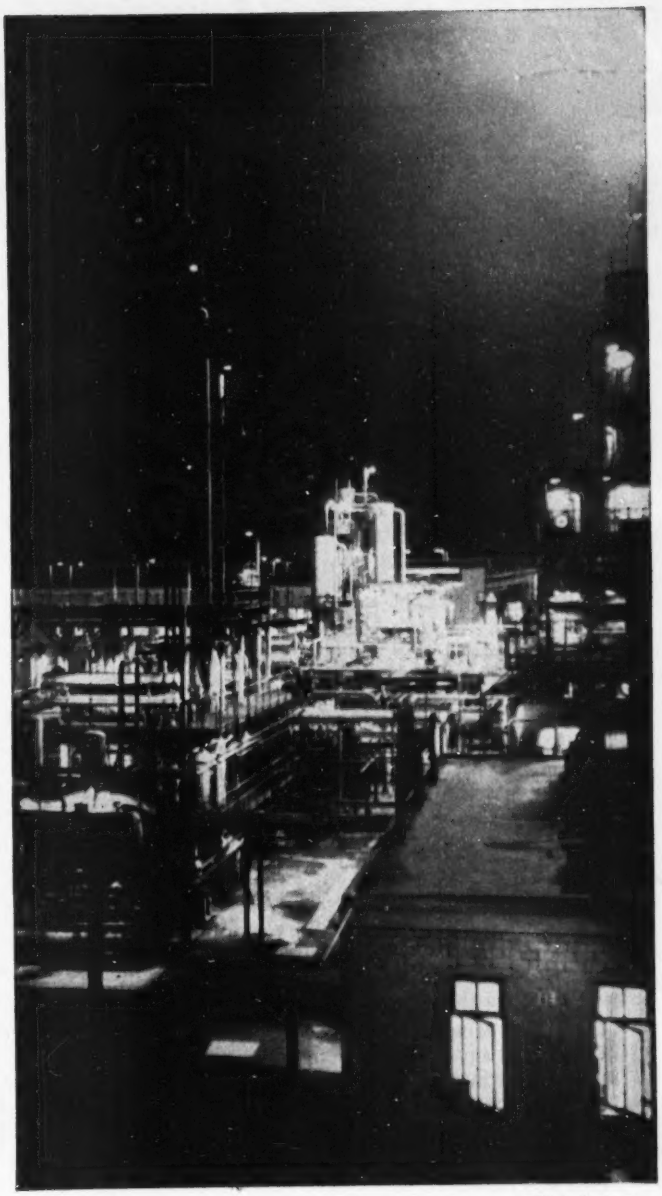
Synthetic rubber. One of the leading rubber companies has recently announced a new synthetic, the formula of which is based on ethylene and propylene glycol, adipic acid and a diisocyanate. The resulting polyester resembles Germany's Vulcollan, but does not have to be finished immediately. Tire treads of the new rubber are reported to have two to five times the wear resistance of cold rubber. Resistance to oxidation is claimed to be superior to both natural and synthetic.

Can Wyandotte tell you how to use glycols in your business?

No. When it comes to your own business, we believe you are the best authority. We will, however, co-operate with your plant and research people, giving them the benefit of our many years' experience as a basic producer of glycols, and putting our thorough knowledge and complete research facilities at their disposal.

Is Wyandotte a good source for raw chemicals?

Many of America's leading industrial concerns think so. Some of them have been doing business with us for close to 64 years. If you are not already a Wyandotte customer, investigate our background — our products and services. We feel certain you will be well satisfied. We can supply you with glycols or their related products in regular or special grades. Mail the coupon today for further information.



Wyandotte's glycol plant works round the clock to keep up with industry's growing demand for ethylene glycol and diethylene glycol.

Wyandotte CHEMICALS

REG. U. S. PAT. OFF.

WYANDOTTE CHEMICALS CORPORATION, WYANDOTTE, MICHIGAN • *Offices in Principal Cities*

HEADQUARTERS FOR ALKALIES

Soda Ash • Caustic Soda • Bicarbonate of Soda • Ethylene Dichloride • Chlorine • Calcium Carbonate • Calcium Chloride • Glycols • Synthetic Detergents • Agricultural Insecticides • Soil Conditioners • Other Organic and Inorganic Chemicals

Wyandotte Chemicals Corporation, Department CE-8
Wyandotte, Michigan

☐ Please send complete information on Wyandotte glycols.
☐ Please have your representative call.

We are interested in using glycols for _____

_____

Name _____ Title _____

Firm _____

Address _____

City _____ Zone _____ State _____

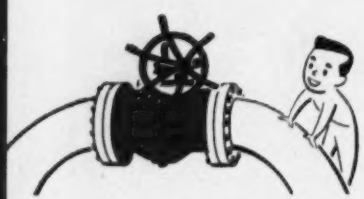
Let's Face the Facts . . .

DOES VALVE LUBRICATION

Now and then someone revives an old argument—"it costs too much to maintain lubricated valves."

On the surface, that sounds logical. But if that really was a fact, millions of Nordstrom lubricated valves in service today could never have been sold.*

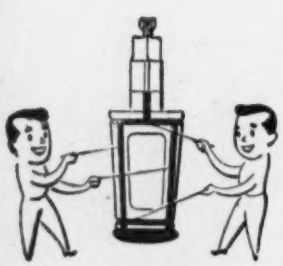
WHAT IS THE ADVANTAGE OF A LUBRICATED VALVE?



The most important function of lubricant in a Nordstrom valve is to give a tighter seal than can be accomplished through any other method yet developed. The thin film of plastic lubricant that is forced around the ports of the plug is a pressure seal in itself.

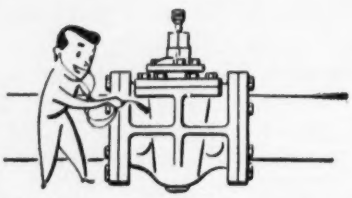
Of course, the lubricant has other obvious advantages—the same advantages it has in your automobile, or in any other mechanical equipment where metal rubs metal. The lubricant all but eliminates the possibility of galling or seizing, and consequently keeps the valve ready to operate in a hurry. A lubricated Nordstrom valve operates easily even against high line pressures, because the plug turns *within* the line, rather than being forced or wedged *against* it. Since it takes only a quarter turn of the plug to open or close the valve, it operates in seconds instead of minutes.

WHAT DOES THE LUBRICANT DO?



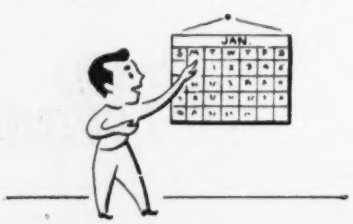
In a Nordstrom valve, lubricant is forced through a series of grooves surrounding the plug ports. There it acts as an extra seal against the little leaks that become big problems. It is also forced into a lubricant chamber at the small end of the plug where it serves as a hydraulic jack to keep the plug easy to turn. Finally, it *lubricates* . . that is, it prevents grinding wear, fills tiny imperfections that may develop, and it lets the plug slide without grating.

WILL A NORDSTROM VALVE WORK WITHOUT LUBRICANT?



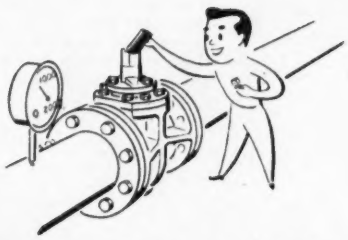
Yes, but then the whole advantage of a lubricated valve is lost. Your car will also operate without lubricant, but with proper lubricant, it is far more efficient, lasts many, many times longer, needs much less maintenance, and is safer. So is a valve. Nordstrom is fundamentally a valve—a plug valve made to exceptional standards of tolerance and quality—but it is the internal Nordstrom lubrication system which raises its performance standards above ordinary valves.

HOW OFTEN SHOULD NORDSTROM VALVES BE LUBRICATED?



Like your car, that depends upon the service—the temperature, process, frequency of operation, etc. It's hard to generalize, but your Nordstrom sales engineer can advise you. Using Rockwell lubricants, made especially for Nordstrom valves, is one way to reduce frequency of lubrication in many cases. Also, Rockwell markets mechanical lubrication equipment to make scheduled lubrication easy. Nordstrom Hypreseal valves are now built with an external fitting so that it is unnecessary to remove any parts from the valve before lubrication.

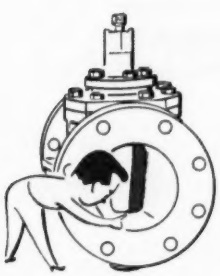
COST MONEY OR SAVE MONEY?



WHAT LUBRICANTS SHOULD BE USED?

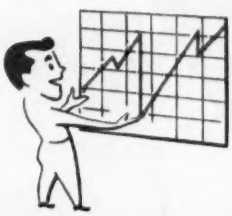
Part of the effect of lubricating your car is lost if you use improper lubricants. That is also true of lubricated valves. Genuine Rockwell lubricants will save you money—they are the result of the longest and most extensive research into valve lubricants by any company. They are the result of years of field experience with nearly every process condition. For many services there are variations of Rockwell lubricants compounded to offset specific line conditions. Also, for many services Rockwell Hypermatic lubricant may be recommended. This lubricant, which is compressible and energizable, regenerates itself in the lubrication system, greatly reducing lubrication frequency. In any case, consult your Nordstrom sales engineer.

HOW LONG WILL PROPERLY LUBRICATED NORDSTROM VALVES LAST?



That's impossible to answer, since many of the first Nordstrom valves put into regular service are still going strong. The service has a lot to do with it, naturally. In gas service, there are many valves with more than 30 years service. In the valve-killing application of drilling rig mudlines, Nordstrom valves have been disassembled for inspection after more than 150,000 feet of hole on many occasions, found to be without wear, and returned for more service—often four times the life of ordinary valves. In a two-year paint plant test, Nordstrom valves were the only ones that did not need to be replaced because of leakage. Nordstrom files are full of such authentic field case histories—ask your Nordstrom sales engineer.

WHAT ABOUT MAINTENANCE COSTS FOR NON-LUBRICATED VALVES?



In any but the most simple services, any kind of valves need *some* maintenance. But in the case of Nordstrom valves, maintenance is generally confined to adding lubricant at intervals. Over a 20-year period, Nordstrom sales of repair parts have been less than half of one per cent of sales. In several plants in which records were kept and where Nordstrom and other valves were used, repair parts for Nordstrom valves ran about one-tenth of other makes.

The analogy to your car carries over here—if you don't lubricate it, you save on lubricant, but pay the far, far higher costs of part replacement. And more particularly, you'll need a new car much more often.

When you consider valve maintenance, be sure to count *all* the costs—not just simple service, but major repairs and complete replacement costs, shutdowns, extra labor to operate, and *all* factors.

If you do, if yours is a typical application, you'll find that year-in and year-out, the most economical valves you can use are Nordstroms.

If you'd like to discuss the suitability of Nordstrom valves for any service, let us know. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Canadian Valve Licensee: Peacock Brothers, Limited.

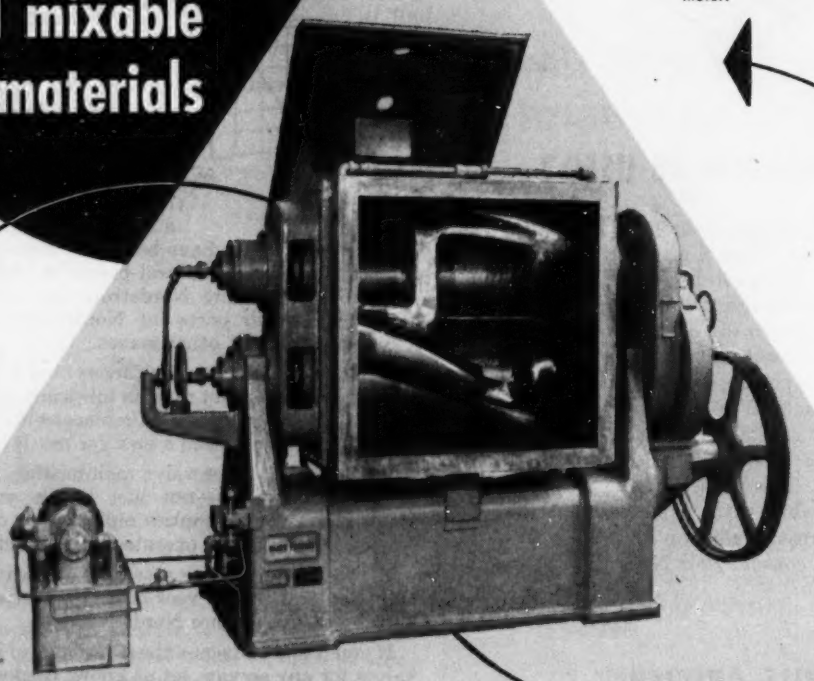
ROCKWELL- Nordstrom VALVES

Lubricant-Sealed for Positive Shut-Off

* Nordstrom invented lubricated valves more than 30 years ago. Since that time, several million have been installed in hundreds of widely varied petroleum, gas, chemical and other process services. With by far the most complete range of sizes and pressures, and many patents on construction details, Nordstrom is the leader in lubricated valves.

BAKER PERKINS

mixers for the rapid efficient mixing of all mixable materials



Size 16—JWIM BAKER PERKINS Universal Vacuum Mixer with overlapping cored Sigma blades and jacketed trough shell. Trough shell and cover are operated by a single control lever. 30 hp motor.

If it can be mixed, there's a BAKER PERKINS Mixer that will do the job thoroughly and efficiently. In capacities to suit your requirements, B-P Mixers can handle materials ranging in consistency from dry powders and light fluids to stiff plastic masses. Here are just a few of the products being made and the mixing and kneading operations now being successfully performed in B-P machines:

Foundry Sand	Color Flushing	Rubber Dispersions
Polyester-Fibers	Plastics	Carbon Products
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Floor Tile	Plastisols	Chemical Reactions
Carbon Electrodes	Blending	Rubber Products
Vacuum Drying	Paint and Varnish	Dog Food

BAKER PERKINS INC.

282

CHEMICAL MACHINERY DIVISION • SAGINAW, MICHIGAN

Remember the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS.

Engineered for tough service

TUBE-TURN CONCENTRIC REDUCERS provide a gentle transition from large to small diameters with strong knuckle contours. They exceed the pipe itself in bursting strength and have fatigue strength equal to that of the joining butt weld.

This extra quality at no extra cost is typical of the entire Tube Turns' line. You can specify TUBE-TURN Welding Fittings and Flanges and *know* that you will get the *exact* answer to your specific piping problem. This leading line includes more than 4000 items in all piping materials, schedules and sizes to match *your* design . . . available promptly through your nearby Tube Turns' Distributor.

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A Division of National Cylinder Gas Company

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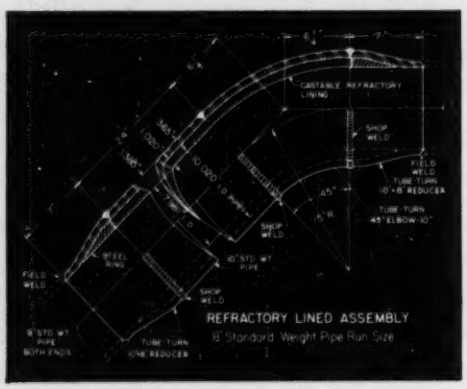
PIPING PROBLEMS

YOUR PIPING PROBLEM?
Here's service to help you...

TUBE TURNS' Engineering Service Division is staffed with men of wide experience to help solve your piping problems. Typical of many they encounter is this:

The general practice in handling highly abrasive materials in piping is to use heavy wall carbon steel elbows for directional changes, and replace these as they wear out. Recently, a new pipe lining . . . a zirconia-corundum refractory . . . was introduced with exceptional wear-resistant properties. This offers a highly satisfactory solution to the abrasion problem. The sketch shows how this lining can be applied to a 45° elbow by combining with two reducers.

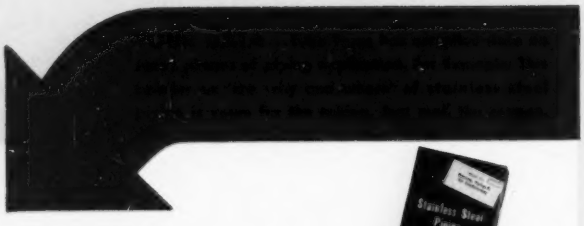
This application is practical for piping of 4" through 12" diameter. Minimum thickness for casting of refractory is about one inch. It should be confined to mild pressure-temperature conditions. Additional details are available from Tube Turns' Engineering Service Division.



Design of 45° directional change with refractory-lined elbow.

YOUR SIZE: These ½-inch and 42-inch TUBE-TURN Welding Elbows are the extremes in the range of diameters available out of stock in carbon steel. Tube Turns' complete line of more than 4000 items includes fittings and flanges in carbon steels, stainless steels, chrome-moly steels, copper, aluminum, brass, monel metal, nickel and wrought iron.

YOUR SOURCE: The nearby Tube Turns' Distributor provides prompt delivery of TUBE-TURN Welding Fittings and Flanges to meet your needs exactly. He acts as your warehouse. He cuts your purchasing red-tape and time. He is backed up by the entire Tube Turns' organization.



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224 East Broadway, Louisville 1, Kentucky

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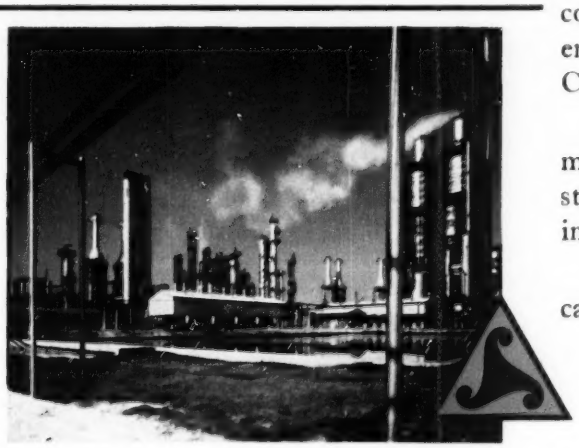
"tt" and "TUBE-TURN" Reg. U.S. Pat. Off.

TUBE TURNS
A DIVISION OF NATIONAL CYLINDER GAS COMPANY
LOUISVILLE 1, KENTUCKY

CONOCO

New installations recently placed in operation at Lake Charles, include units for crude oil distillation, catalytic cracker feed preparation, Thermofor catalytic cracking, gas recovery, catalytic polymerization, catalytic reformer feed preparation and aromatics extraction.

GREATER CAPACITY– EFFICIENCY– ECONOMY FOR CONOCO



For Continental Oil Company, Stone & Webster Engineering Corporation designed and constructed seven types of process units and enlarged an existing alkylation unit at the Company's Lake Charles, Louisiana, refinery.

Continuous flow through several of the units minimizes the need for intermediate offsite storage facilities; and all units are closely integrated for high heat economy.

These new units more than tripled the capacity of the refinery.

Write or call us for detailed information as to how our engineering, design, construction, report and appraisal services may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS LIMITED (LONDON)

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Toronto

for TOUGH fluid and gas handling jobs

ATLANTIC

FLEXIBLE METAL HOSE

Conveying nitric acid for use in batch nitrations is quick death for ordinary flexible metal hose. Sulphuric acid and plating solutions are other notorious killers. When temperature and pressure extremes and adverse handling conditions are also involved, hose replacement is frequent and expensive.

That's why—for tough jobs—it's good economy to specify Atlantic flexible metal process hose. Manufactured to survive the most destructive use, it is unequalled for leak-proof qualities, flexibility, durability, strength and lightness. It performs long after ordinary hose is scrapped and returns real savings in your material and labor dollar.

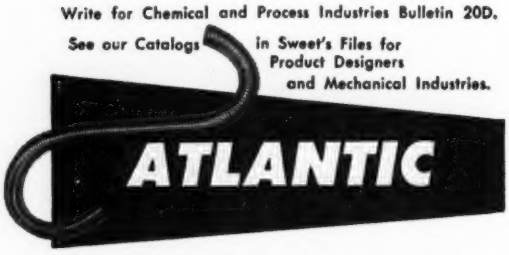
Whatever your application — conveying, controlling movement and vibration, correcting misalignments, compensating for expansion and contraction — *there is an Atlantic flexible metal hose that is best for it.*

Available in Seamless or Interlocking construction: Steel, stainless steel, monel, bronze. ¼"—36" I.D. inclusive with appropriate fittings.

Our engineers have developed flexible metal hose for a number of classified nuclear applications. Though these types cannot be released at present, the experience gained is available for any unusual problems you may have.

Write for Chemical and Process Industries Bulletin 20D.

See our Catalogs in Sweet's Files for Product Designers and Mechanical Industries.



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Air-Quenching
COOLER

FIND OUT—How Many Ways This Cooler Can Cut Costs for You!

SAVE ON INSTALLATION You save up to 30% on installation costs over comparable coolers. Pre-tested and pre-assembled, your cooler is shipped to your site in two sections where it is easily installed without costly revamping of plant. Less headroom is required — there are fewer costly auxiliaries.

SAVE ON FUEL Movable baffle in air housing above clinker bed isolates and directs hottest air to kiln. Combustion efficiency is greatly increased.

SAVE ON POWER Uniform bed of material passing over grating requires only low pressure air. Comparatively smaller fan and motor uses only about ½ hp-hr per barrel of clinker. Fewer auxiliaries to drive.

SAVE ON MAINTENANCE Simplified design and small number of parts require little attention. Low upkeep cost. Lubrication is required only on drive mechanism. Only four grease fittings. Horizontal grate system insures smooth flowing bed of material and high efficiency cooling throughout. There is little or no wear on grates or grate warpage. Maintenance is only about 1/10 cent per barrel of clinker.

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Contains valuable engineering information on cooling that can help make your operations more profitable! It's a book you'll want to have and keep.

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Milwaukee 1, Wis.

Please send my copy of Air-Quenching Cooler Bulletin 07B7869.

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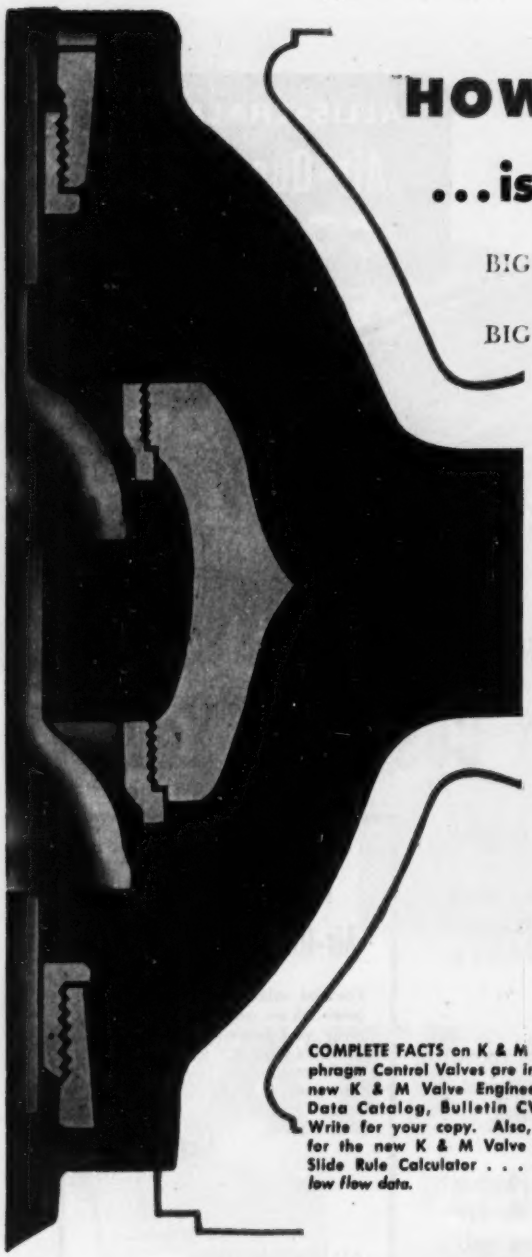


HOW BIG

...is a K & M six-inch valve?

BIG enough to pass 500 gpm of cold water through the valve body at a constant drop of one pound pressure. BIG enough to provide the largest flow coefficient available in a standard six-inch diaphragm control valve. Body flow passages of all K & M valves, for example, actually average 140% of cross-sectional pipe area. There's more space for fluid to flow . . . smoothly, freely and without turbulence. Frequently a smaller nominal size K & M Valve provides sufficient capacity to satisfy requirements that formerly called for a larger, more expensive valve. Inner valve open areas, on the other hand, average only 80% of cross-sectional pipe area. Therefore, flow restrictions occur principally across the inner valve . . . where the restriction is controllable throughout the entire range of valve stem travel. This K & M design often permits lower initial costs . . . always contributes to more precise flow regulation through the K & M Inner Valve.

COMPLETE FACTS on K & M Diaphragm Control Valves are in the new K & M Valve Engineering Data Catalog, Bulletin CV53. Write for your copy. Also, ask for the new K & M Valve Size Slide Rule Calculator . . . with *low flow data.*

C_V COMPARISON TABLE

Valve Size	K & M	Valve B	Valve C
⅛"	10.9	8.4	8
1"	17.3	14.9	12
1½"	39.1	33.2	28
2"	61	57	48
2½"	97.7	71.0	72
3"	150	116	100
4"	219	197	165
6"	500	364	360

Based on the maximum C_V at rated travel through the valve body. From manufacturers most recent slide rules or tables.

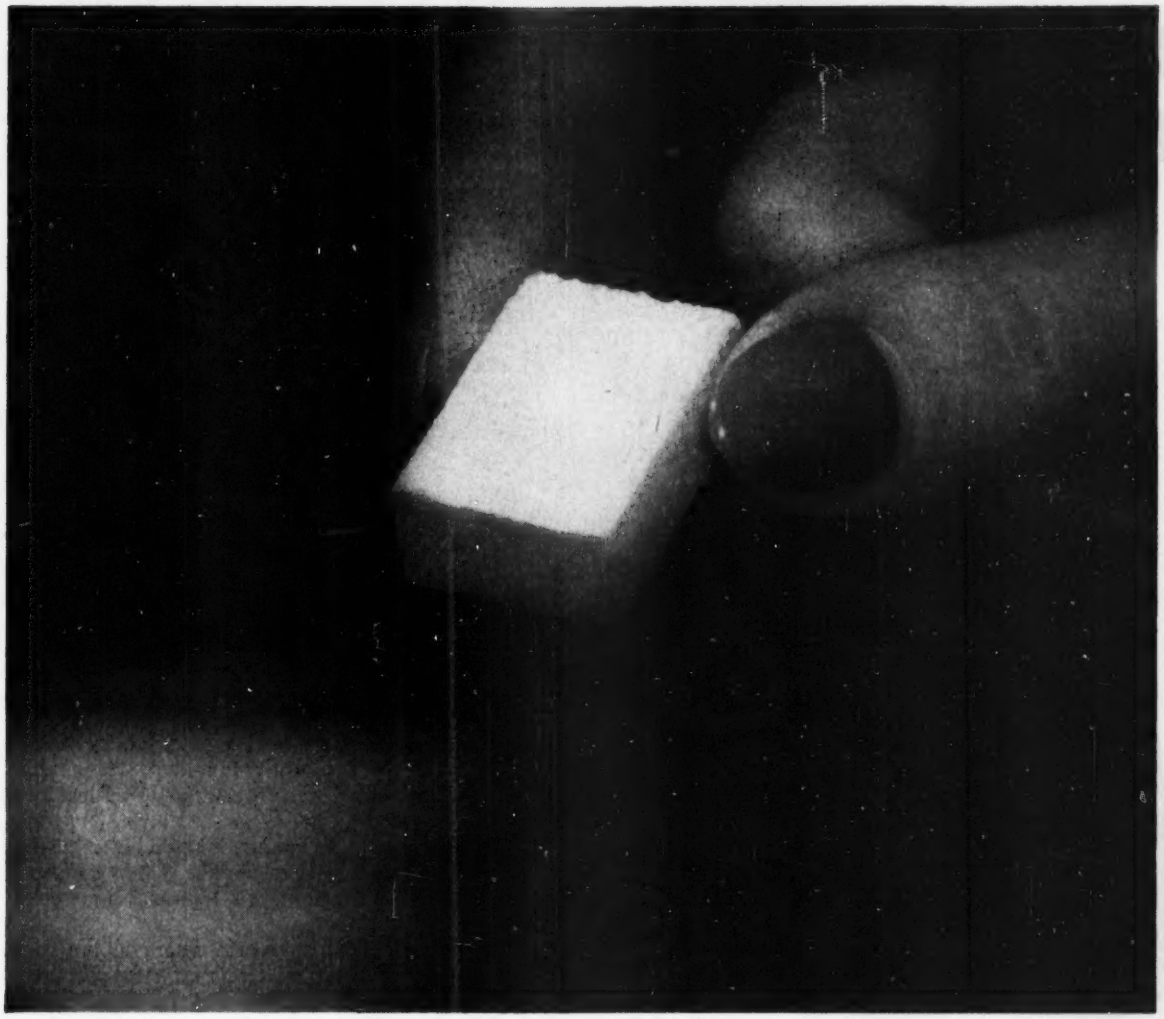
diaphragm control valves

K&M

Valve Makers Since 1879

KIELEY & MUELLER, INC.

64 Genung Street
Middletown, New York



"VIRGINIA" SODIUM HYDRO IMPROVES RAW SUGAR PRODUCTION

Maybe there's money in this story for *you* too!

The sugar industry has discovered that "Virginia" Sodium Hydrosulphite ($Na_2S_2O_4$), when added at the right point in process, improves crystallization, increases purity and steps up the yield. This has meant an added and substantial profit for sugar men.

Here is a case typical of many where "Virginia" reducing and bleaching agents, SO_2, sodium and zinc hydrosulphites have saved important money.

Over the past 20 years, Virginia technical men have made significant contributions in adapting Virginia Chemicals to more than 40 diverse industries. This technical know-how can be invaluable to anyone who is looking into a new development or a process improvement. This, plus a dependable and economical chemical supply source, is good reason for calling in "Virginia" during the early planning stages.

Industrial Department
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Field Offices: NEW YORK • BOSTON • DETROIT
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Available in Canada and many other countries

LETS TANK... WA...
NO BRE...

PENFLEX TUBING
ADDS FLEXIBILITY TO RIGID LINES

Large storage tanks must move with the heat or cold. Rigid connections on one installation were constantly breaking. Flammable liquids leaked out . . . a fire hazard was created, material lost and maintenance costs rose.

The answer was a length of 12" I.D. Penflex four-wall interlocked flexible tubing installed with tight-packed flanges. Tanks can now "walk" with the weather, tubing is tight as a pipe and no special supports were necessary for installation.

In the petroleum or the chemical industries wherever the conveying of liquids, gases or granular materials for storage tanks, engines, compressors or other types of equipment is necessary with flexibility you'll find Penflex "Flexineering" has the answer. Penflex manufactures a complete line of four-wall interlocked and seamless welded corrugated flexible tubing . . . metallic hose, tubing or couplings from 1/8" I.D. and up . . . automatic barrel fillers, accessories and fittings.

Pennsylvania Flexible Metallic Tubing Company, Inc., 7234 Powers Lane, Phila. 42, Pa.
***Branch Sales Offices:* Boston • New York • Chicago • Houston • Cleveland • Los Angeles**

PENFLEX

HEART OF INDUSTRY'S LIFE LINES

EVAPORATION in SECONDS!

The unique Rodney Hunt Turba-Film Evaporator gives incredibly fast one-pass evaporation of liquids, slurries and gases... especially heat-sensitive substances... all by continuous process!

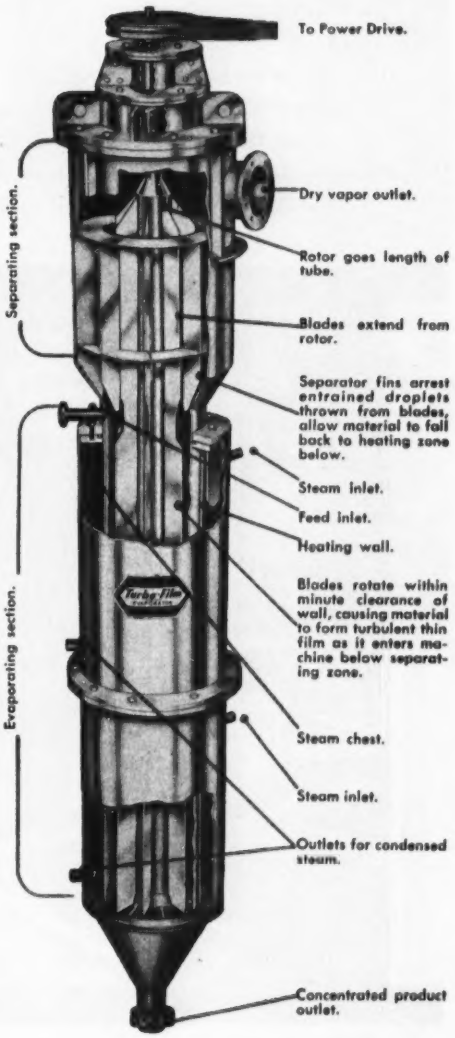
The Turba-Film Evaporator employs a totally different concept of evaporation. Makes heretofore extremely difficult evaporating processes simple and rapid. Actually evaporates most substances in a few seconds!

Here's how the patented Turba-Film works. The substance to be evaporated is fed into the evaporating section. Here it is whirled against the wall by controlled-speed rotor blades. This forms a thin turbulent film, centrifugally held to the wall, which spins in a gravity flow through the chamber and out... completing the process. The vapors rise into the separating section where rotor blades beat out any entrained droplets and force them back through the evaporating section.

So thorough is this Turba-Film process that no substance requires re-circulation... the desired concentration is achieved in one pass! So fast is the Turba-Film action that proper heating is done in seconds. Colors, flavors, nutritional and other valuable properties are retained to a much higher degree... especially in heat-sensitive substances.

Because of its new principle, the Rodney Hunt Turba-Film Evaporator (Luwa Process, Switzerland) permits quick change-over from one product to another; prevents foaming and frothing difficulties; allows constant quality control to be maintained; permits concentration to very much higher viscosities and solids content than is practical with conventional equipment.

Please consider our complete engineering staff at your disposal for consultation on any possible Turba-Film application. We have the facilities for making test runs in our pilot plant: or we can provide a portable laboratory unit for use in your own plant. Mail this coupon for free color brochure explaining the Turba-Film Evaporator in detail.


To Power Drive.
Separating section.
Dry vapor outlet.
Rotor goes length of tube.
Blades extend from rotor.
Separator fins arrest entrained droplets thrown from blades, allow material to fall back to heating zone below.
Steam inlet.
Feed inlet.
Heating wall.
Evaporating section.
Blades rotate within minute clearance of wall, causing material to form turbulent thin film as it enters machine below separating zone.
Steam chest.
Steam inlet.
Outlets for condensed steam.
Concentrated product outlet.

Models available in ranges from 40 to 5000 pounds of water evaporation per hour. Stainless steel construction.

RODNEY HUNT®

Manufacturing Engineers since 1840

RODNEY HUNT MACHINE COMPANY

Process Equipment Division

31 Vale Street, Orange, Massachusetts

RODNEY HUNT MACHINE COMPANY
31 Vale Street, Orange, Mass.

Please send Free brochure giving details of Turba-Film Evaporator

Name.....Title.....

Company.....

Address.....

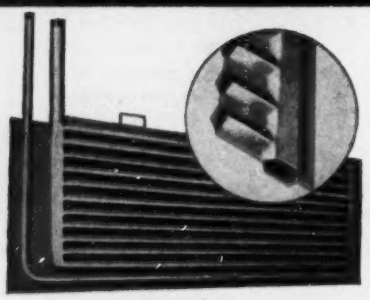
City.....Zone.....State.....

Type of Industry.....Product.....

☐ I want details on your testing program. CE-8-54

PLATECOILS *cured coil-itis** *and tripled the capacity of this tank*

At the tank pictured below at Continental Motors Corp., three crankcase sections can be cleaned at one time when Platecoils are used as the heating medium, while only one crankcase can be cleaned with pipe coils in the tank. Continental has also found that the high efficiency of the Platecoils provides fast heating for quick starts. Their flat surface coats less frequently and takes only about half the time to clean when it does.



Bulletin P61 shows how Platecoils are replacing pipe coils at a savings throughout industry. Send today for your copy.

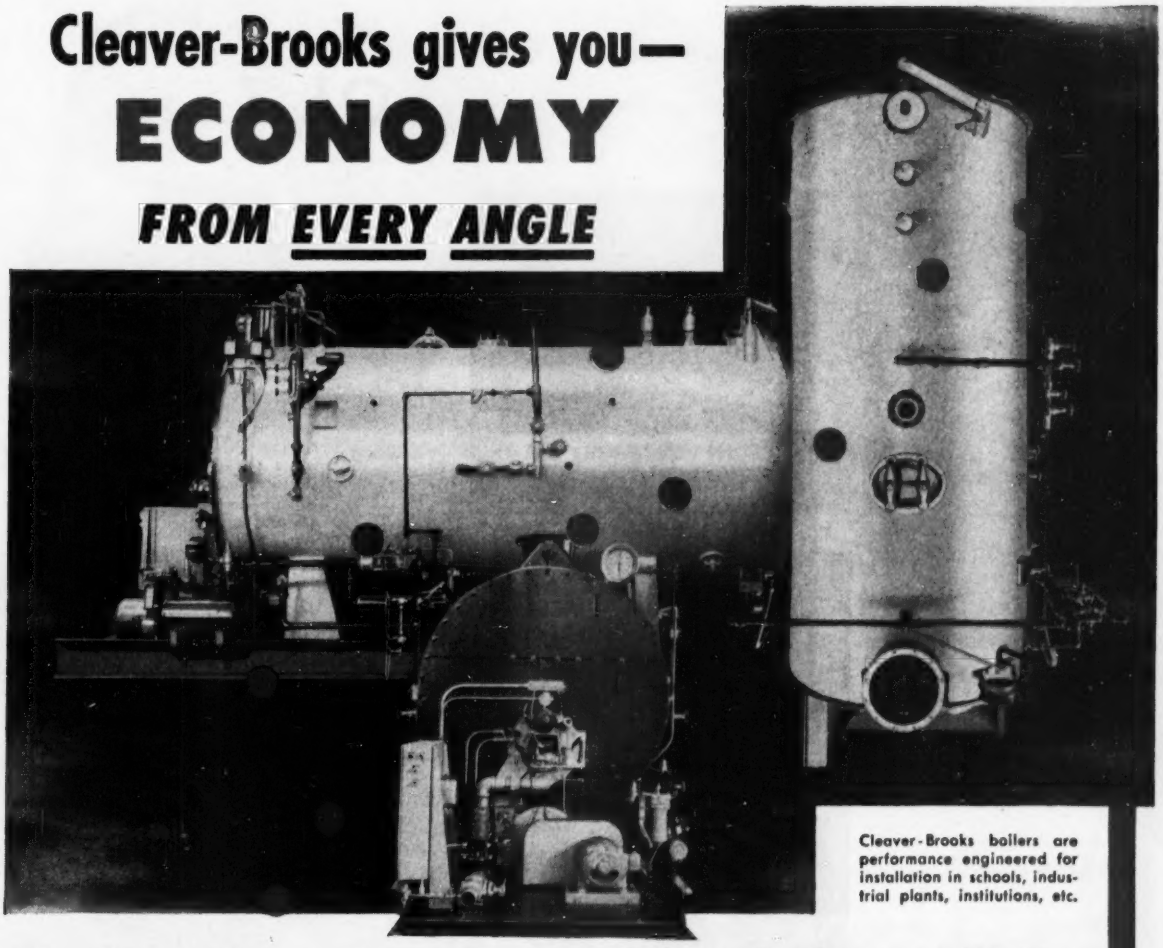
PLATECOILS *replace pipe coils for 50% of the cost*

* Coil-itis is the constant doctoring of wet processing tanks for pipe coil troubles. It can be cured easily by replacing pipe coils with Platecoils. Immediately, you will notice the difference as Platecoils put new life and profits into your heat transfer processes. They heat or cool 50% faster and take 50% less space in the tank. They save as much as 50% in initial cost and 50% in maintenance costs in addition to overcoming the limitations and operating difficulties of old-fashioned and outmoded pipe coils.

Platecoil Division, TRANTER MANUFACTURING, inc., Lansing 4, Michigan

For fast shipment see your local distributor

Cleaver-Brooks gives you—
ECONOMY
FROM EVERY ANGLE



Cleaver-Brooks boilers are performance engineered for installation in schools, industrial plants, institutions, etc.

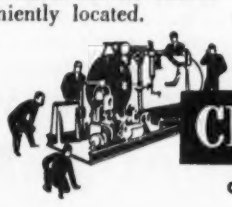
Use this guide to plan present and future boiler installations

Here are basic reasons why Cleaver-Brooks self-contained boilers SAVE money wherever installed. Remember these advantages when expanding your present plant or replacing obsolete boilers. For complete details, write for catalog AD-100, Cleaver-Brooks Co., Dept. J-344 E. Keefe Avenue, Milwaukee 12, Wisconsin, U.S.A. — *Cable address: CLEBRO — Milwaukee — all codes.*

- **SAVES FUEL** — greatest efficiency and fuel economy through high-heat transfer of four-pass, forced draft boiler design.
- **SAVES SPACE** — boilers are compactly self-contained. Use less boiler room area. Fit into low headroom locations.
- **SAVES SERVICE** — factory assembled with trouble-free, quality components. Tested and backed by Cleaver-Brooks' one-source responsibility. ASME code constructed.
- **SAVES MAINTENANCE** — oil, gas or combination oil/gas firing eliminates bulky fuel handling. Designed for easy cleaning and inspection.
- **SAVES EXPENSE OF SPECIAL EQUIPMENT** — boilers available for hot water or steam service . . . heating or processing applications.
- **SAVES INSTALLATION COSTS** — no special foundation needed. Set boiler on existing concrete floor. Simple, roof-high vent eliminates costly smoke stack. Service connections conveniently located.
- **SAVES THRU FUEL FLEXIBILITY** — uses most economical and available fuel in your area. Exclusive burner permits 10-second gas/oil interchange.
- **SAVES BY QUICK STEAMING** — meets fluctuating steam loads automatically. Electronic controls start and stop burner. Safety controls assure 100% protection.
- **SAVES MANPOWER** — fully automatic operation. All controls easily accessible and all normal maintenance can be done by men without special training.
- **SAVES PLANNING TIME** — standard design in 15 to 500 hp; 15 to 250 psi gives you custom planning for single or multiple units.

IT PAYS TO PLAN FROM ALL ANGLES TO GET GREATEST BOILER ECONOMY — PLAN WITH CLEAVER-BROOKS — WRITE FOR DATA TODAY

"It's NEW — get the facts on the CB boiler — write today!"



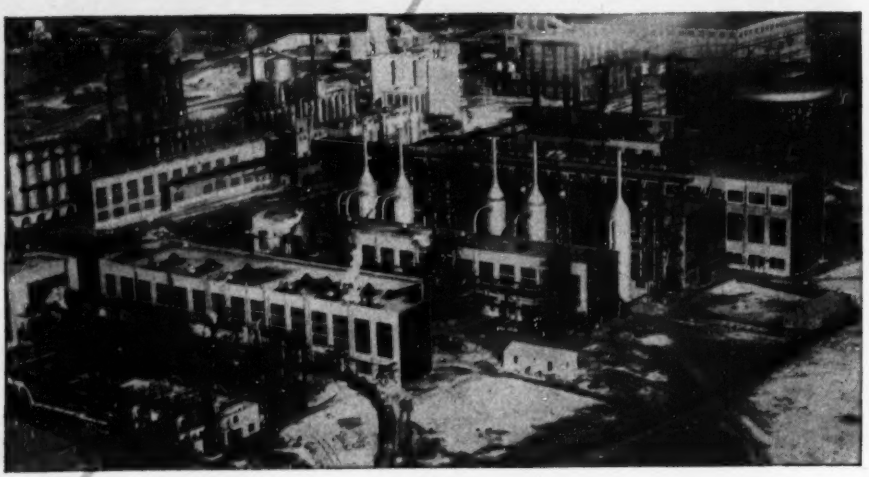
Cleaver Brooks

ORIGINATORS OF THE SELF-CONTAINED BOILER

Oh, I see

Nitrogen Division's South Point, Ohio plant where ARCADIAN 12-12-12 Fertilizer, Ammonia, Urea, Nitrogen Fertilizer Solutions, Formaldehyde and other chemicals are produced.

Nitrogen Division's Hopewell, Virginia, plant where ARCADIAN Nitrate of Soda, Ammonia, Nitrogen Fertilizer Solutions, Ammonium-Nitrate-Limestone and other chemicals are produced.



...they're using our valves at the *Nitrogen Division*

ALLIED CHEMICAL & DYE CORPORATION

Chemical processors must be particular about the valves they buy. The success of a plant's operations can depend on the efficiency of the valves controlling the production flow.

Design of OIC Valves is based on the strict specifications of chemical processors. That's why OIC has gained ready acceptance by the Nitrogen Division of Allied Chemical & Dye Corporation and others in the industry. You can rely on OIC Valve dependability in your industry, too.

Write for catalog information or engineering assistance.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

OIC FOUNDED 1884

VALVES | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON**

Here's another
new lubrication
improvement
from Standard Oil

WHITE

NEW STANOLITH GREASE

A new grease! White and clean in appearance, STANOLITH Grease White is the perfect grease for use in food and beverage plants.

Specially recommended for bakeries, breweries, candy factories, canning and cereal plants, chemical processing plants, dairies, distilleries, meat processors — all industries where clean, sanitary operating conditions are at a premium.

● STANOLITH Grease White is a new high quality, multi-purpose lithium soap grease with a clean, white color. It assures you of unmatched lubricating cleanliness *plus* unmatched lubricating efficiency.

In addition to the high-temperature and water resistant properties, characteristic of most lithium greases, STANOLITH Grease White has superior mechanical and chemical stability. It provides a water-resistant lubricating film that gives this remarkable grease extended multi-purpose usage in a wide variety of applications. Easily handled in all usual types of grease-dispensing equipment, it is safe, easy-to-use, clean. Call your nearby Standard Oil lubrication specialist for full details on new STANOLITH Grease White.

STANDARD OIL COMPANY *(Indiana)*

STANDARD

Aerial view of the Kansas City, Kansas, Works, Fairbanks, Morse & Co., 3601 Kansas Avenue.

...from Kansas City

Yes, from our new, modern-as-tomorrow works at Kansas City, we serve the world's needs for pumps.

As a major supplier of quality pumping equipment, it is particularly suitable that this new Fairbanks-Morse plant be located at an important crossroads of the world . . . Kansas City. In this new plant 190,000 square feet of manufacturing space and a complete foundry occupying 150,000 square feet are devoted to bringing better service to our customers all over the world.

Modern manufacturing, development and testing equipment backed by engineering and production skills of highly trained personnel combine to produce products of unmatched quality . . . in performance, durability, economy. Fairbanks, Morse & Co., Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering when you want the best

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • FARM MACHINERY • MAGNETOS

Why the **MICHIGAN*** Tractor Shovel moves bigger yardage – *the Clark Torque Converter®*

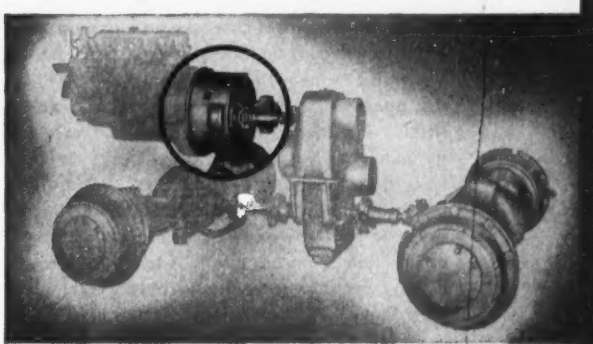
You can do miraculous things with a MICHIGAN* Tractor Shovel because of *extra power when it's needed*—a result of 3-to-1 torque multiplication in the CLARK Torque Converter.

● **Digging into TOUGH Material**—watch a MICHIGAN *force* its bucket into tough, compacted material: not a "shock" action—but a steady, resistless flow of *increasing power* that puts no punishing strain on the driving shafts and gears. Torque multiplication plus the terrific digging power of the hydraulic bucket rams enable the MICHIGAN to perform unbelievable feats.

● **Maintenance and Down-time reduced to a minimum**—the CLARK Torque Converter eliminates the engine clutch: the weakest link in a conventional power-train and the unit most frequently requiring repair.

● **Make ANY Shift at ANY Time**—with the Torque Converter, driving is as easy as handling your car! Shift into Forward or Reverse, into High or Low range *while moving in either direction* . . . the Torque Converter absorbs shocks.

● **Standard Equipment on All Models**—Clark is first to present a full line of Tractor Shovels with Torque Converter as standard equipment. See the MICHIGAN Tractor Shovel. Watch it in action, demonstrating its astonishing power, speed and maneuverability.



Talk to your MICHIGAN dealer; and send for the MICHIGAN Fact Folio, handy file of specifications and action photos—the coupon gets prompt action.

*A Trademark of Clark Equipment Company ©Clark manufactured under Schneider License

19A

CLARK EQUIPMENT

CLARK EQUIPMENT COMPANY
Construction Machinery Division
432 Second Street
Benton Harbor, Michigan

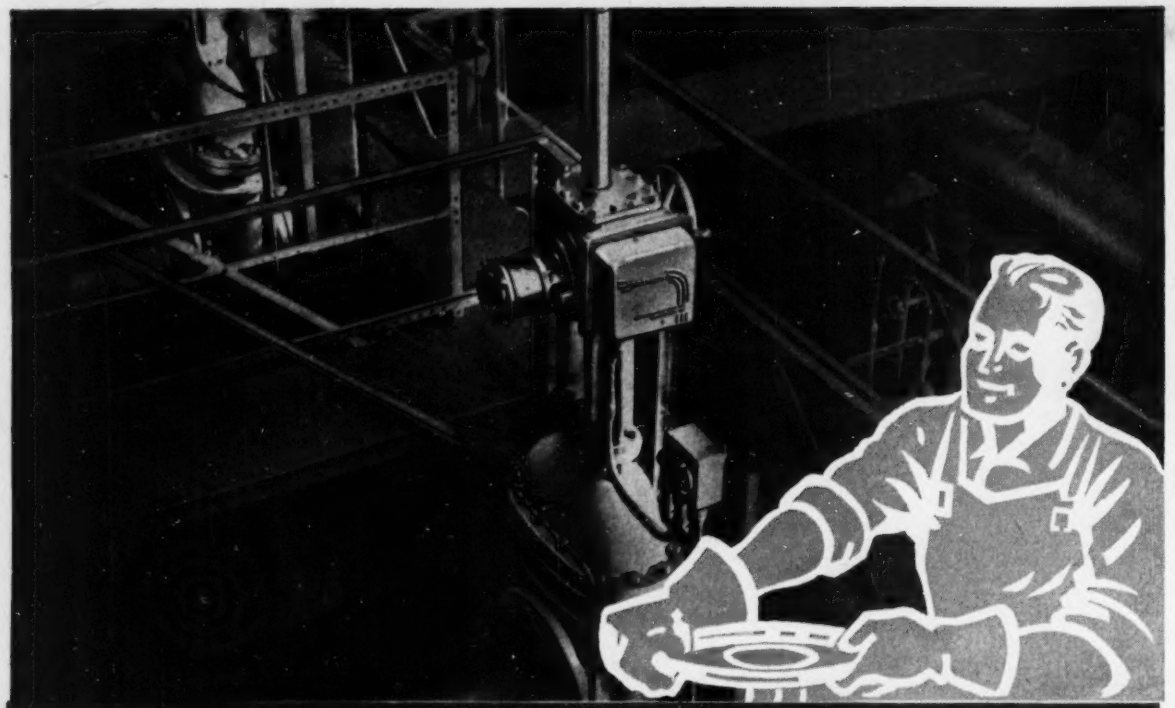
Please send the MICHIGAN Tractor Shovel FACT FOLIO

Name_____ Title_____

Firm_____

Address_____

City_____ County_____ State_____



this man is never missed

WHEN *Limitorque*® IS USED

The familiar sight of a workman climbing around to open or close valves is unnecessary. . . . Now, he *merely pushes a button* at a conveniently located station or a master control panel. . . . Valves operate quickly, dependably and safely. LimiTorque provides complete safety to workmen, by eliminating the need of climbing to out-of-the-way, hazardous locations for manual valve operation; also vitally important, valve operation parts are protected from damage by the automatic shutting-off of the motor if an obstruction is encountered. LimiTorque may be actuated by any available power source . . . electricity, air, water, gas, or oil.

Thousands of LimiTorques are in daily use, in Power Plants, Water and Sewage Plants, Chemical and Process Plants, Paper Mills, Oil Refineries, Oil and Gas Pipe Lines, —and on Shipboard. LimiTorque Motor Operated Valves are readily adapted to Microwave Control.

Write for LimiTorque Catalog L-54 for further details.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Here's aluminum chloride

in the RIGHT SIZE for your use

Most often, a particular process using aluminum chloride, anhydrous, works best with a selected particle size.

We have taken technical liberties in this picture (exposing aluminum chloride to the air) to show you the *four* sizes available from Hooker.

Extra work of screening isn't necessary when you specify Hooker aluminum chloride. The four sizes give you a choice that will meet just about every process requirement:

1. *Extra fine grind* is unscreened, with 90 to 95% passing 40 mesh.
2. *Fine grind* is unscreened, practically all passing 20 mesh.
3. *Coarse grind* is unscreened, 1 mesh and finer. It contains 25 to 35% finer than 20 mesh.
4. *Coarse screened* is the same as coarse grind (No. 3), but is screened to remove 20 mesh and finer.

Before re-ordering your requirements, get the facts on Hooker aluminum chloride. For technical data, just phone the nearest Hooker office listed below, or mail the coupon today.

Need other chlorides? This is only one of several metal chlorides available from Hooker. Chlorinated organics and inorganics are specialties with us; we've been making them for more than 30 years. If you need a special chlorine-containing compound in quantity, we may be able to produce it for you economically. To find out quickly, just phone the nearest Hooker office or write us today.

FOR FAST SERVICE, PHONE:

CHICAGO	CEntral 6-1311
LOS ANGELES	NEvada 6-3826
NEW YORK	MUrray Hill 2-2500
NIAGARA FALLS	6655
TACOMA	BRoadway 1215

HOOKER ELECTROCHEMICAL COMPANY,
5 Forty-seventh St., Niagara Falls, N. Y.

Please send:

- ☐ Data sheet on Hooker aluminum chloride, anhydrous
- ☐ Bulletin 100 describing Hooker products and services

Name..... Title.....

Company..... Address.....

City..... Zone..... State.....

HOOKER CHEMICALS

From the Salt of the Earth

3-1495

HOOKER ELECTROCHEMICAL COMPANY

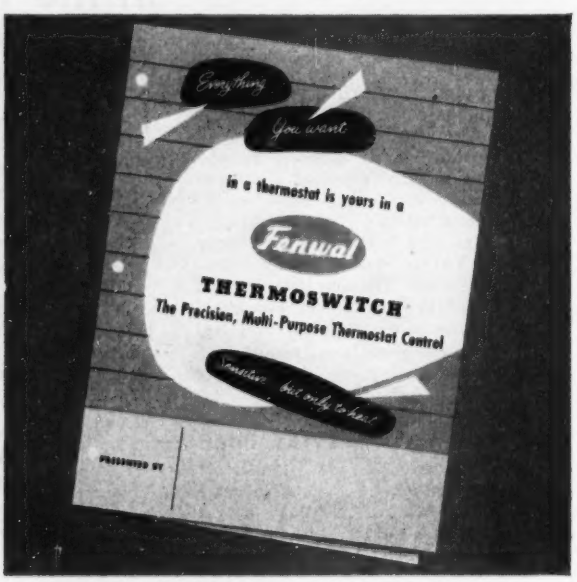
NIAGARA FALLS • TACOMA • MONTAGUE, MICH. • NEW YORK • CHICAGO • LOS ANGELES

How would YOU solve these two problems?

1. A PATCH AHEAD OF TIME, applied at the factory, reinforces the knees of dungarees and overalls. Patches are vulcanized under pressure with Radio Frequency Corp.'s high frequency, dielectric heater. If dielectric heat, generated in the material, is lost through conduction, vulcanization becomes inefficient. But Fenwal THERMOSWITCH® units in each platen minimize these losses by close temperature control. Vulcanizing 3000 patches per hour is now standard; 30 was.

2. DENTAL PLATE FIT STARTS WAY BACK. The tiny abrasive wheels for grinding and polishing dental plates must be very accurately molded of fine abrasive in a rubber base. The molds in which they're made must have delicate temperature control for consistent quality and uniformity. The manufacturer, The Wm. R. Hall & Son Co., uses THERMOSWITCH units in molds for accurate, reliable temperature control. Production figures can be kept high while rejects are low.

3. THIS IS IT — the Fenwal THERMOSWITCH control is simple — compact shell contracts or expands *instantly* with temperature changes, opening or closing electrical contacts. Adjustable and highly resistant to shock and vibration. Fenwal THERMOSWITCH units are solving temperature problems and helping to improve the final product throughout all industry.



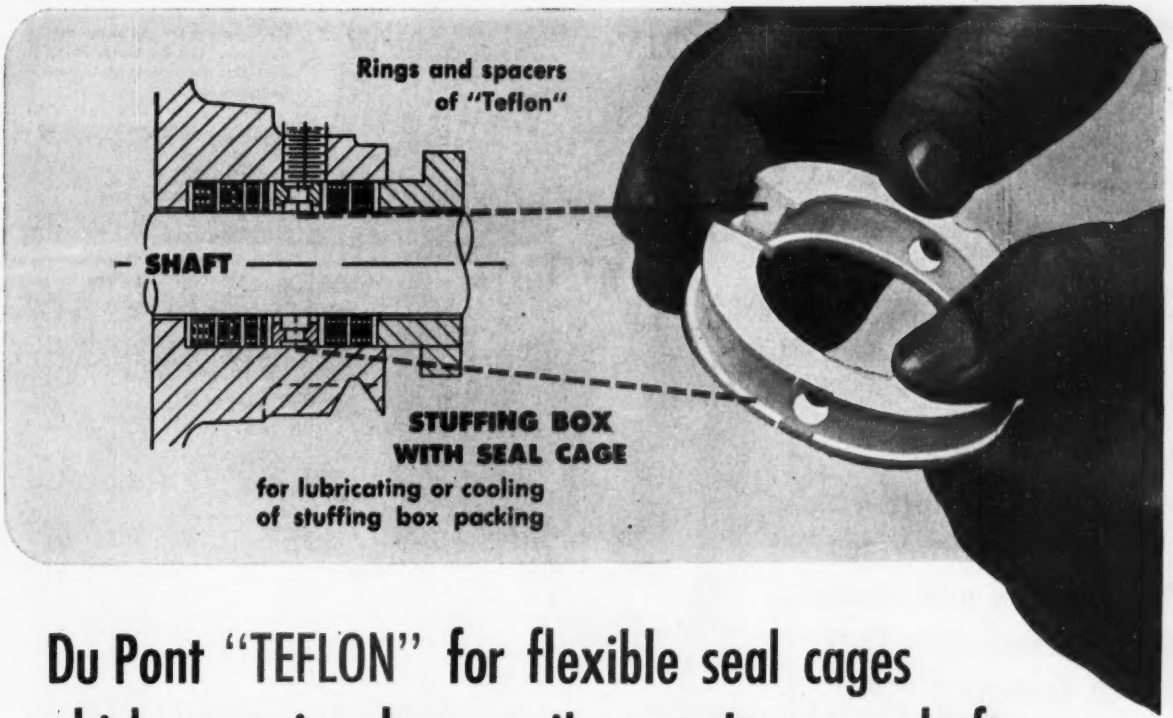
4. SEND FOR THIS BROCHURE for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal Incorporated, 168 Pleasant St., Ashland, Massachusetts.

Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE... *but only to heat*



Du Pont "TEFLON" for flexible seal cages which snap in place easily, won't score shaft

"Teflon" is strong and chemically inert . . . offers users of process equipment many unique advantages

These flexible seal cages of Du Pont "Teflon"* tetrafluoroethylene resin supply annular space in packing for lubrication with oil or grease, or for cooling. Users of pumps and other process equipment will appreciate how quickly and easily these flexible seal cages of "Teflon" snap on and off a shaft. They're tough—won't bend or collapse under extreme gland pressure. Yet there's no danger of a scored shaft or sleeve from these seal cages of "Teflon," manufactured by Chemical and Power Products, Inc., New York City.

Today "Teflon" is used extensively in process industries. Its chemical inertness, high heat resistance, low temperature toughness and low coefficient of friction make this engineering material particularly adaptable to severe service conditions.

Have you and your company investigated the properties of "Teflon" and the other members of the Du Pont family of engineering materials—"Alathon"* polyethylene resin, "Lucite"* acrylic resin and "Zytel"** nylon resin? By evaluating their properties in terms of your own design and service problems, many product improvements may prove possible.

Use the coupon below for complete information on the Du Pont engineering materials.

*Registered trademark of E. I. du Pont de Nemours & Co. (Inc.)
**Trademark of E. I. du Pont de Nemours & Co. (Inc.)

DU PONT
TEFLON®
Tetrafluoroethylene resin
Better Things for Better Living
. . . through Chemistry

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 258, Du Pont Building, Wilmington 98, Delaware

Please send me more information on Du Pont "Teflon" tetrafluoroethylene resin: Uses ☐; Processing Techniques ☐; Properties ☐. I am also interested in receiving more information on: "Zytel" nylon resin ☐; "Alathon" polyethylene resin ☐; "Lucite" acrylic resin ☐.

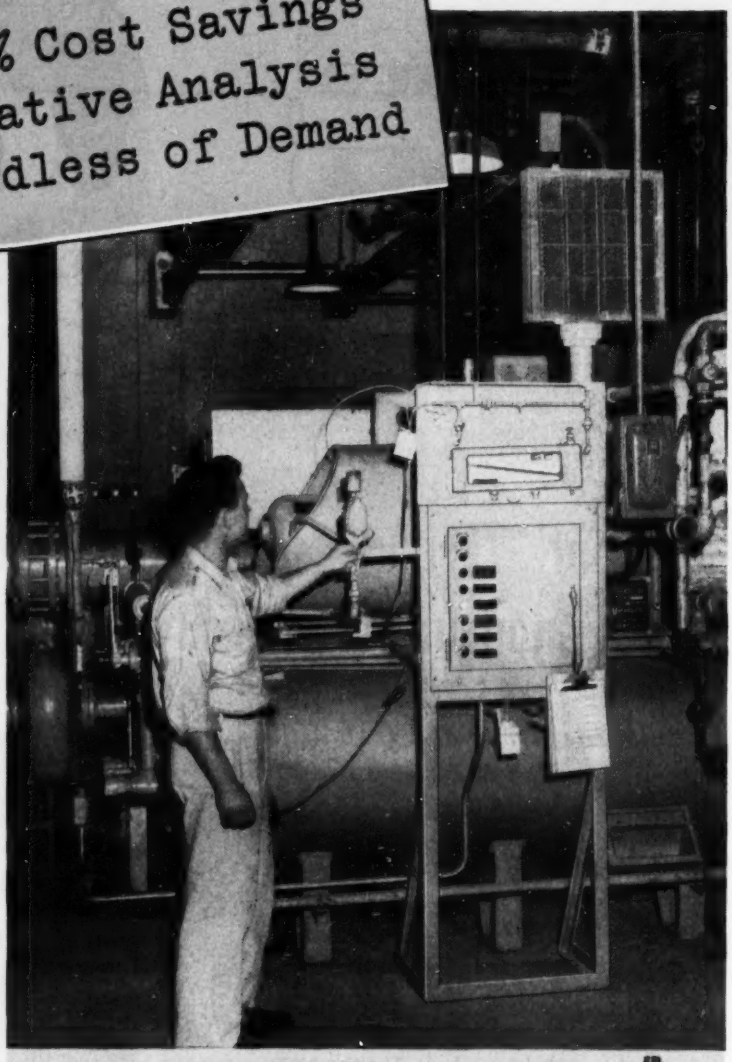
Name _____
Title _____
Firm Name _____
Street Address _____
City _____
State _____
Type of Business _____

Case No. 105

Upjohn Company Reports:

- Estimated 90% Cost Savings
- Exact Qualitative Analysis
- Purity Regardless of Demand

Operator is shown observing test burner at the top of the control panel for the Kemp M1HE Inert Gas Generator at Upjohn Company.



How Kemp Inert Gas Generator Provides Process Gas and Reduces Fire Protection Cost in Cortisone Plant

Regardless of the demand for inert gas—both for processing and for fire protection service—Upjohn Company, Kalamazoo, Michigan, reports that their Kemp M1HE Generator delivers exact qualitative analysis of gas at high purity.

The installation operates in their new plant, opened in 1953 to provide starting material for the Upjohn fermentation process used in manufacturing USP Cortisone—one of many fine pharmaceuticals manufactured for the ethical drug field by Upjohn.

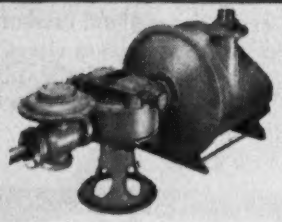
The Kemp M1HE Inert Gas Generator provides 13% carbon dioxide and 87% nitrogen, both for processing use and to replace the costly cylinder gas formerly used for fire protection. Fired by natural gas, the generator has a capacity of 8,000 cfh.

User Very Enthusiastic

Since installation of the unit, Upjohn Company estimates costs of gas have been reduced 90% . . . purity of the gas is constant . . . exact qualitative analysis is maintained up to full generator capacity.

Kemp Can Help You

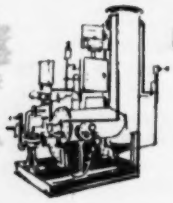
If you still rely on inefficient, unsatisfactory methods of providing inert gas, let Kemp help you, too. Kemp engineers will gladly discuss your specific problems with you—without obligation, of course. So write today for complete information.



Close-up of the Kemp Industrial Carburetor, the heart of every Kemp installation. It assures the desired analysis of inert gas under any demand without waste, without adjustments.

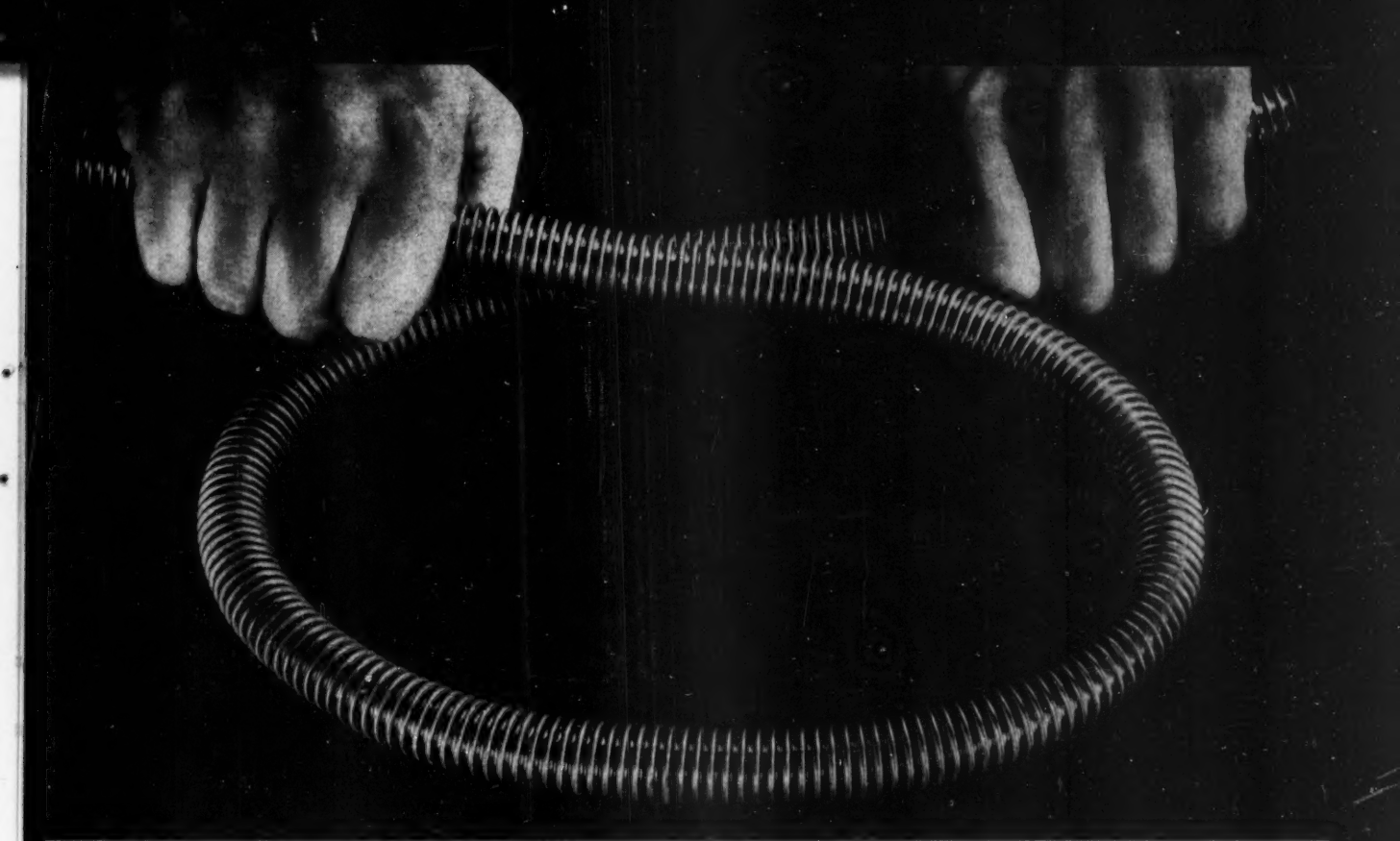
For more complete facts, ask for Bulletin No. I-10. Write to:
C. M. KEMP MFG. CO., 405 E. Oliver Street, Baltimore 2, Maryland.

KEMP OF BALTIMORE



INERT GAS GENERATORS

ADSORPTIVE DRYERS • SINGEING EQUIPMENT
IMMERSION MELTING POTS
CARBURETORS • BURNERS • FIRE CHECKS



American Flexible Stainless Steel Tubing meets tough design "specs"

- **Conveys corrosive gases and liquids at high temperatures—high pressures**
- **Stands up under continuous flexing**
- **Absorbs severe vibration**
- **Compensates for misalignment**
- **Takes movement and offset motion**

Today industry looks to "American"—a leader for over forty years in the manufacture of flexible metal hose and tubing — as a dependable source for flexible *stainless steel* tubing. This tubing is specially engineered and manufactured to give desired flexibility with greatest durability.

American Flexible Stainless Steel Tubing is annularly corrugated, and is made in both open and close-pitch construction. It is available in Types 316 and 321, ranging in size from ¼" I.D. through 4" I.D. Assemblies are made up with or without wire braid covering to meet most industrial working pressures. American stocks a line of standard fittings. These are attached to the tubing in our own plant by Heliarc welding or silver brazing.

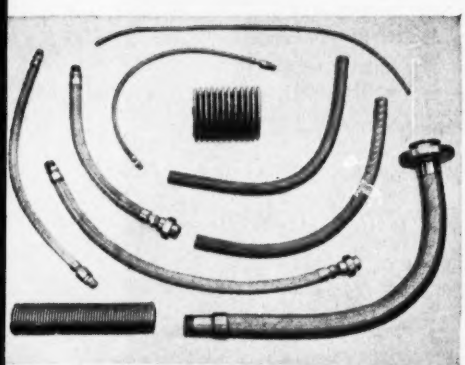
Send us details of your connector problem. "American" engineers can help you solve it.

WHEREVER CONNECTORS MUST MOVE

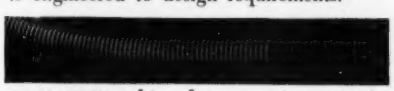
AMERICAN

flexible metal hose and tubing

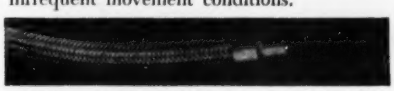
an ANACONDA® product



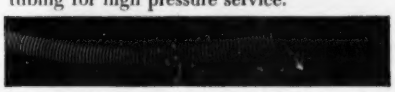
WIDELY USED in processing of food and chemicals, American Flexible Stainless Steel Tubing is engineered to design requirements.



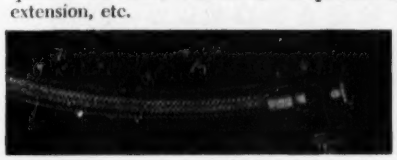
OPEN PITCH tubing for conveying corrosive liquids and gases, exhaust, hot air, etc. under infrequent movement conditions.



STAINLESS STEEL BRAID gives extra strength to tubing for high pressure service.



CLOSE PITCH tubing for extra flexibility, frequent movement, vibration, compressions, extension, etc.



ASSEMBLIES, complete with fittings attached, manufactured to your specifications.

FREE BOOKLET!

Gives engineering data on construction and types of American Flexible Stainless Steel Tubing. Includes information on fittings. Write today for your free copy.

The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn.

Please send me Bulletin STC-1 on American Flexible Stainless Steel Tubing.

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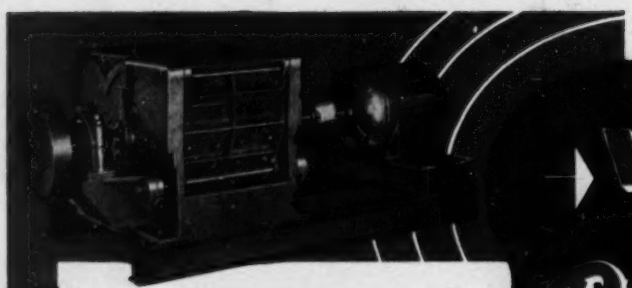
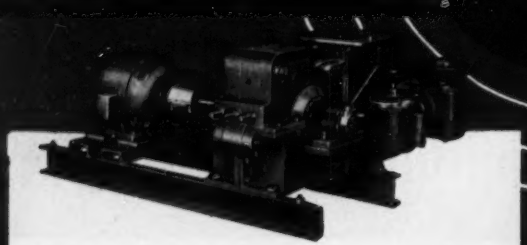


WILLIAMS has the Right Answers to all your GRINDING, CRUSHING, SEPARATING PROBLEMS

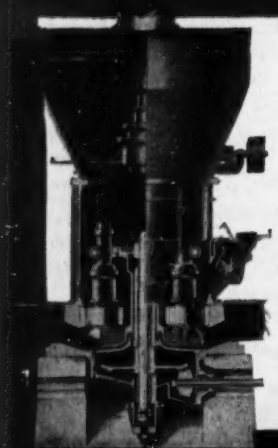
HAMMER MILLS

A size for every purpose! Williams Hammer Mills are designed to do the **complete job in a single operation.** No primary or secondary crushers required—extra foundations, conveyors, other expensive equipment are eliminated—thus saving as much as 75% on initial investment and up to 50% on grinding costs!



HELIX-SEAL HAMMER MILLS

Combines the advantages of a hammer mill with screw-type feed to obtain finenesses from 100 to 325 mesh. For dustless, cleaner, safer dry grinding—accurate, non-clogging reduction of sticky and wet materials. Eliminates separators, fans and cyclones. Furnished with water or steam jackets.



ROLLER MILLS WITH AIR SEPARATION

Pulverizes and blends with exceptional accuracy down to 400 mesh or micron size. Dries as it grinds. Instant size adjustment—automatic self-adjusting feed—many other exclusive features that mean improved quality and output.

Whether your job demands crushing power shovel-loaded stone to 8 mesh or smaller in a single operation—whether it is pulverizing or blending, with or without air separation, of limestone or insecticides to finenesses down to 400 mesh, or even micron sizes—whether it is closed-circuit dustless dry grinding, or the grinding of wet and sticky materials to 325 mesh—there is a Williams "proved-in service" machine that can give you **A BETTER PRODUCT—FASTER PRODUCTION—and LOWER COSTS.**

It will pay you to get the facts about Williams equipment, and learn what it can do for your specific operation. **Write Today For Literature.**

Send Us Your Questions

Complete testing and research facilities are maintained by Williams to develope the **right answers,** especially for your operation, on every size reduction problem. Write for information and the help of an experienced Williams technician.

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- **Drier and Impact Mills**
- **Air Separators**
- **Vibrating Screens**
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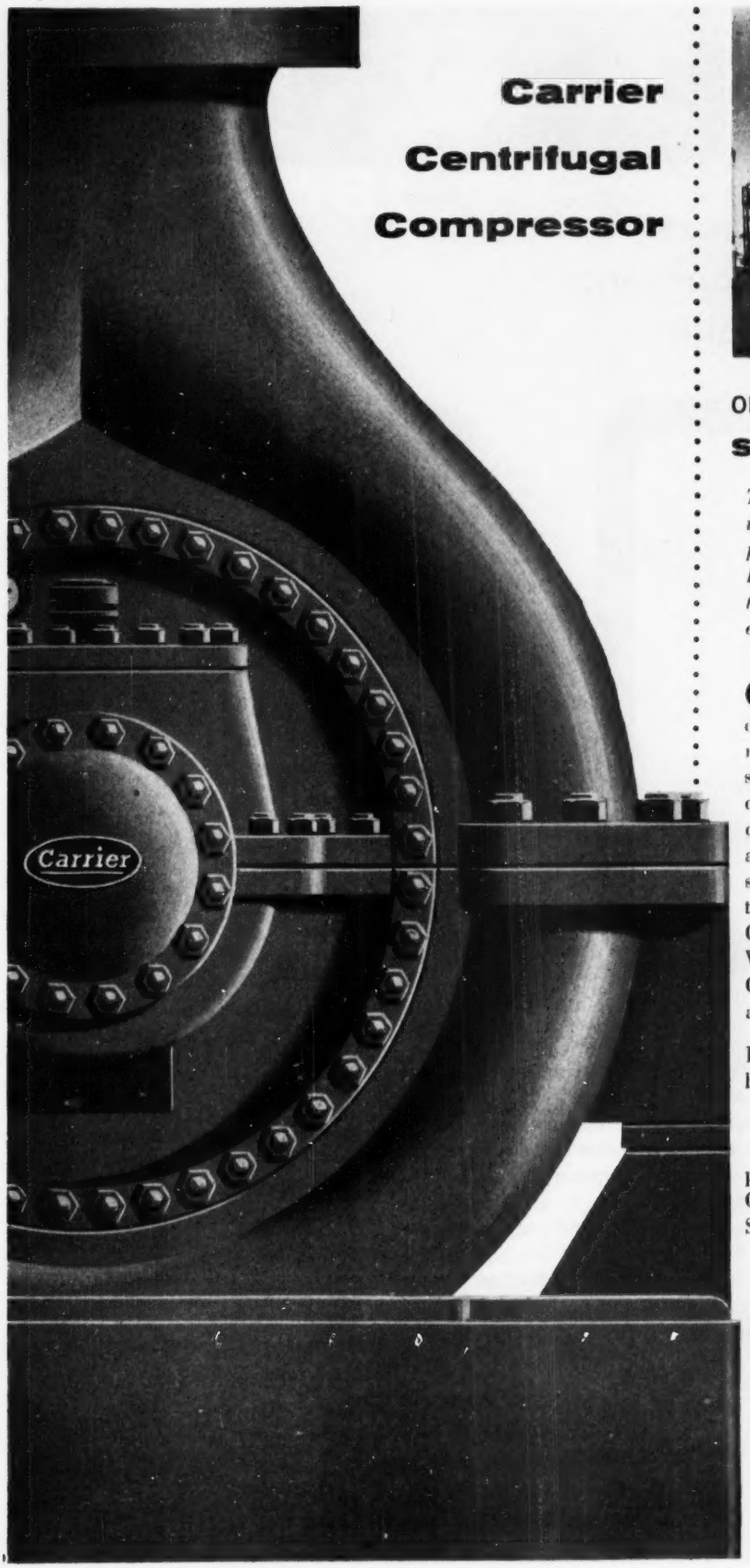
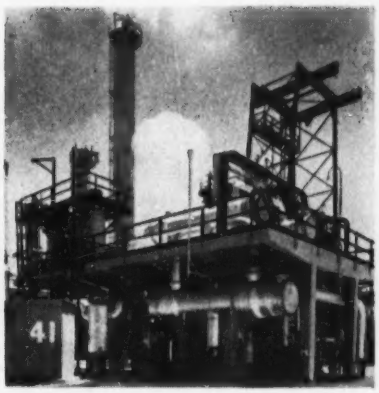


Carrier Centrifugal Compressor



on the job at

Sinclair Refining Co.

This Carrier Centrifugal Compressor is on the job at Sinclair Refining Company's Corpus Christi, Texas, refinery. Handling 2195 c/m of isobutane, the compressor is turbine-driven by exhaust steam.

Carrier makes a complete line of centrifugals for gas compression and refrigeration—up to 10,000 hp in a single unit. There are hundreds of these dependable, efficient Carrier machines on the job at dozens of chemical plants and refineries across the country—serving such companies as The Atlantic Refining Company, Reichhold Chemicals Co., Cities Service Co., Wyandotte Chemicals Corp., Standard Oil Company of California. May we assist *you?*

If you'd like a copy of our informative booklet,

"Centrifugal Compressors for Industry,"

please call your nearest Carrier office. Or write direct to Carrier Corporation, Syracuse, New York.

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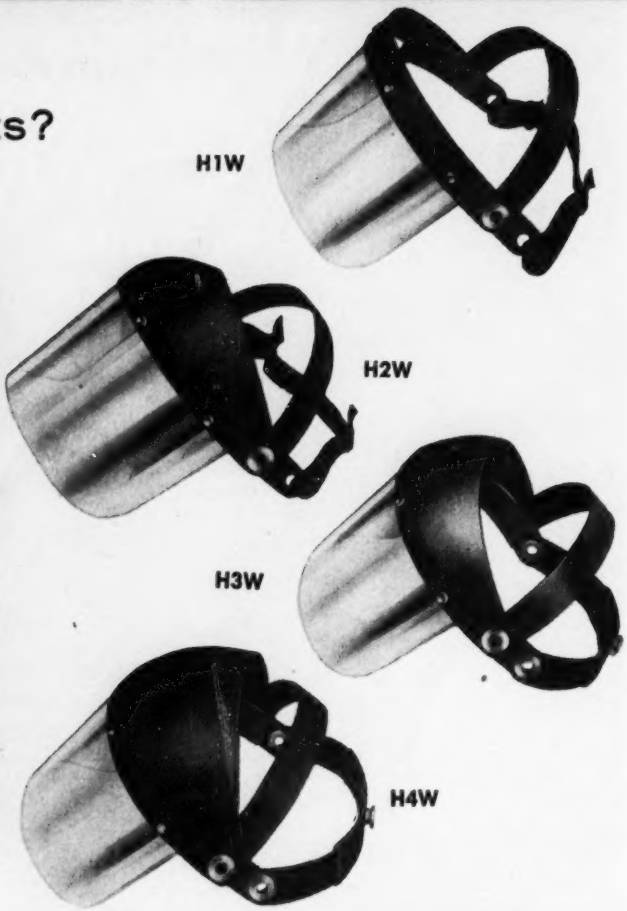
AO "H" SERIES
FACE SHIELDS



AO research and engineering step forward again with several additional safety advances in facial protection for your workers! This NEW Face Shield Series features a deep spark deflector which blocks foreign particles from entering at top of face shield. Window sets out about ¾" to allow adequate clearance over nose and prescription glasses. An AO exclusive is the slot and snap fastener device which, by allowing for expansion due to heat, eliminates wear at the holes, and cracking, warping and distortion of the windows. (U. S. Patent No. 2,610,323). Another new development is the lightweight grommet-friction washer combination for permanent adjustment. Your nearest AO Safety Products Representative can supply you with these quality shields.

QUICK FACTS

Specially treated (anti-perspiration) soft, genuine leather sweatbands.

Windows easily interchangeable (simplifies handling, stocking, assembling).

Windows available in clear or green acetate, 24 mesh screen, and fibre.

For complete details on all 4 "H" Series Face Shields (H1, H2, H3, H4) write for new brochure S-2141 . . . do it to-day.

RECOMMENDED USES: For metal sawing, chemical operations, buffing, sanding, light grinding, light bulb and glass bottle manufacturing, radio and television tube exposures, bottling operations and similar eye and facial hazards encountered in industry.

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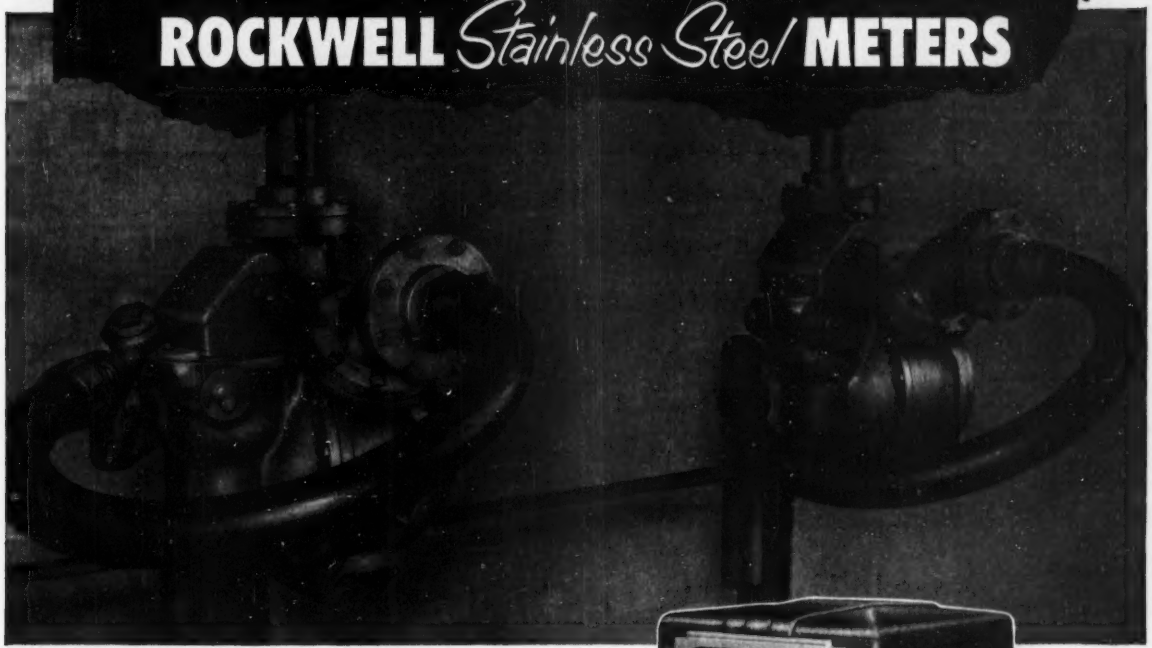
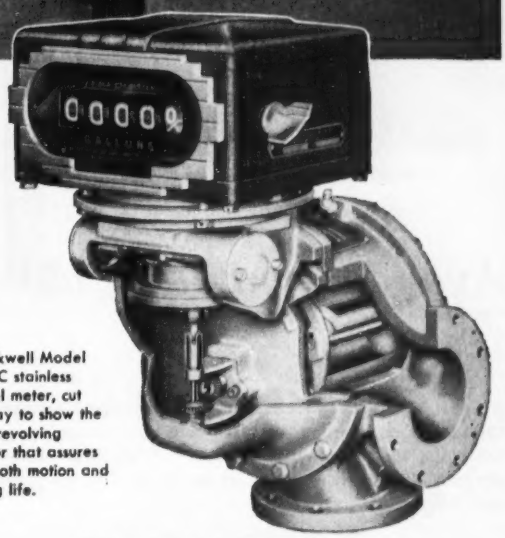
ROCKWELL *Stainless Steel* METERS



MEASURE CORROSIVE LIQUIDS!

Including Foods, Pharmaceuticals, Chemicals and Liquors

Here's a meter especially designed for accuracy and long life when measuring corrosive liquids. It is constructed *inside and out* of stainless steel. With it you can get positive metered accounting for a multitude of liquids that cannot be handled by ordinary meters. Now you can guard the quality of your formulations; keep tab on liquid inventories; have accurate records for cost control and tax analysis purposes. Use the handy coupon for full details.



Rockwell Model 2-BC stainless steel meter, cut away to show the all-revolving rotor that assures smooth motion and long life.

Use for all these purposes

- **LIQUID DELIVERY CONTROL**
- **COST. CONTROL—DEPARTMENT CONTROL**
- **FORMULA CONTROL—INVENTORY CONTROL**
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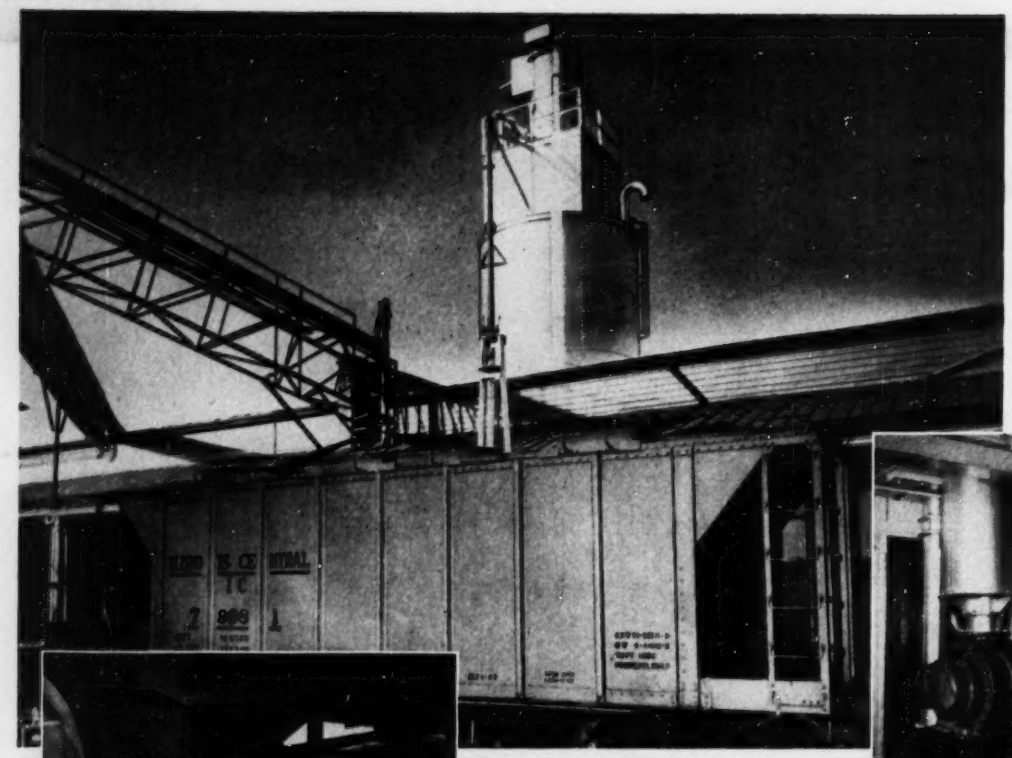
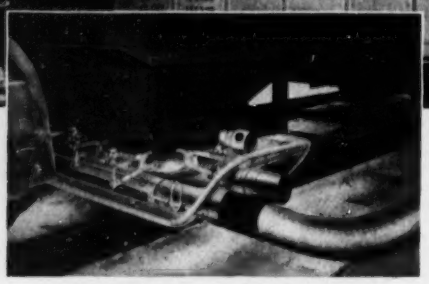
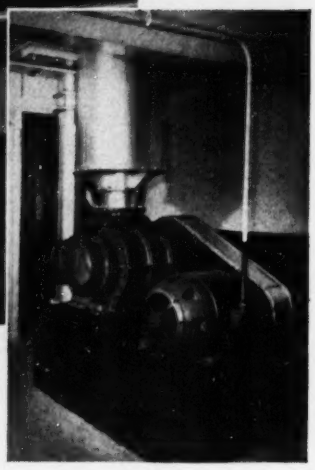


Hopper-bottom car being unloaded. Airveyor filter installed above storage bin. Shows permanent conveying duct from car to filter.



Portable twin nozzle attached to car hopper.



Exhauster unit which furnishes the air-power for the Airveyor system.

Avondale unloads bulk starch with The AIRVEYOR®

Avondale Mills at two of its plants, Alexander City and Pell City, Alabama, is using the Airveyor System for unloading and conveying bulk starch from hopper-bottom cars. Illustrated above is the system installed at Alexander City for unloading and delivering the starch to a storage bin.

Previous to the installation of the Airveyor System at Alexander City, starch was received in bags; some were broken in transit and in trucking from cars to the warehouse.

The Airveyor has changed this. Waste is reduced to a minimum; hand trucking is eliminated. Labor required—two men to attach and detach twin nozzle to hoppers of the car. Unloading time, approximately 2 hours and twenty minutes for one car. Starch is available to the slasher room from the storage bin with a capacity of approximately three carloads.

If you are still *manhandling* your incoming starch in bags, it will pay you to get all the facts about the Airveyor for pneumatic conveying. Why not take advantage of Fuller's 27 years of experience in air-conveying? Write today for full information.

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The Industries We Serve—AGRICULTURE

His challenge: Keep 15 plates filled!

AND to do it, your friend, the American farmer, has a real fight on his hands: Against weeds—they starved out $5 billion worth of crops last year. And against insects—they took a $4 billion bite.

By 1980, there will be nearly 200 million Americans—more people than the land can feed at present production rates. Only better farming methods—and especially better weed and insect killers—can fill the hungry gap.

America's chemical industry is already performing miracles for the farmer. A revolutionary insecticide, introduced to U.S. agriculture by Pittsburgh Coke & Chemical, makes the entire plant self-protecting against many insects. New herbicides kill weeds before they sprout but are completely harmless to the crops they protect.

Today, Pittsburgh's Agricultural Chemicals Division serves American agriculture with a wide range of important, basically-produced *"Pittsburgh"* farm chemicals. And to provide the farmer with his food-saving weapons of tomorrow, our laboratories are conducting intensive, continuing research.

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COKE & CHEMICAL CO.

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COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

It's the Nash!

The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintains 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

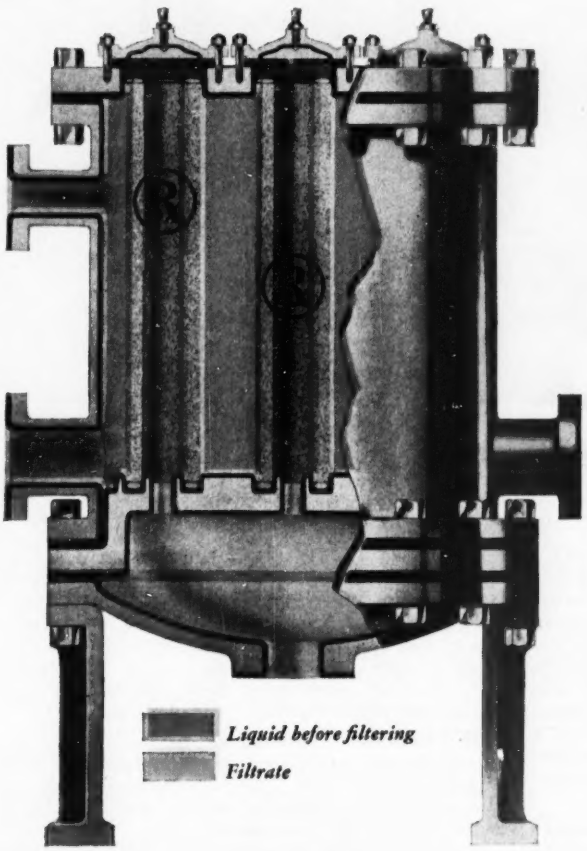
- No internal wearing parts.
- No valves, pistons, or vanes.
- No internal lubrication.
- Low maintenance cost.
- Saves floor space.
- Desired delivery temperature Automatically maintained.
- Slugs of liquid entering pump will do no harm.
- 75 pounds in a single stage.

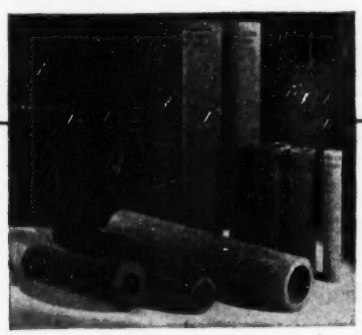
NASH ENGINEERING COMPANY

312 WILSON, SO. NORWALK, CONN.

Another Norton **R** *on the job!*

Outstanding performance of Adams filters aided by Norton seamless porous tubes





R. P. Adams Co. Filters, covering many chemical filtering services, deliver sparkling clear filtrate and insure quick cleaning without disassembly. Adams filters handling acid or neutral solutions are equipped with Norton seamless porous tubes, *engineered and prescribed* for faster, more thorough filtering and backwashing.

Besides assuring fast, thorough filtering action, Norton porous tubes are extremely easy to clean by backwashing. Here are several good reasons why they excel in these two primary essentials of efficient, economical filter performance:

- Norton porous tubes are made of ALUNDUM* (fused alumina) *engineered* by Norton for chemical stability, inertness and other properties necessary to withstand acid, neutral and slightly alkaline liquors.
- Like all Norton ALUNDUM porous mediums they are made with the patented *controlled structure* process that assures even distribution of pores — for uniform passage of both filtering and backwashing liquids.
- They are *seamless,* providing unobstructed diffusion over their entire area — for further efficiency in both filtering and cleaning.

Other big advantages

of all Norton porous mediums include ease of installation and exceptional resistance to breakage and chipping. Available in sizes and open-pore ratios to meet your needs, they're *engineered* to last longer and cut your operating costs — and they're *prescribed* for a wide variety of chemical services, such as filtering water or solvents . . . cutting oils, wine, etc. . . . reclaiming cleaning fluids and industrial waste . . . and for boiler feed water treatment.

See your Norton Representative for further facts or write, describing your requirements, to NORTON COMPANY, 507 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

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Making better products... to make other products better

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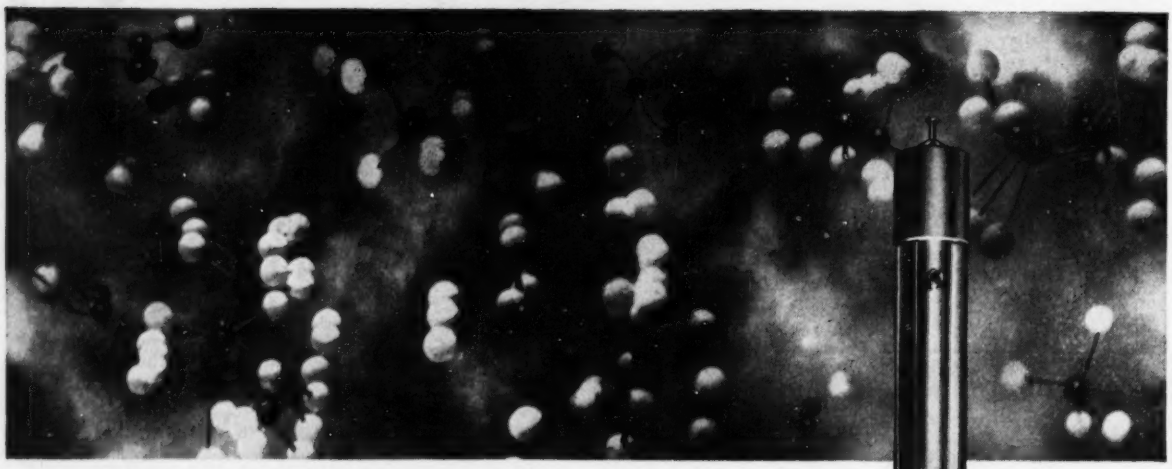
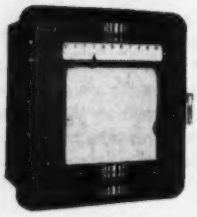


Spotlight your gas compounds

WITH AN L&N

INFRARED GAS ANALYZER



• Ethylene purity—SO_2 loss—methane build-up—isobutane loss—each is a different gas measurement, in a different process, for different end products. But all are being measured successfully by L&N's Infrared Gas Analyzer, expressly designed for *plant analyses* of gas compounds in multi-component streams.

Typical of the Analyzer's application is measurement of SO_2 in H_2SO_4 stack gas, over the narrow range of 0 to 2% SO_2, with these results—

Stability—0.01% SO_2

Sensitivity—0.005% SO_2

Readability—0.005% SO_2
(Reading taken at 0.2% SO_2)

This highly precise measurement is possible because the Analyzer is engineered by L&N to meet the requirements of actual plant operation.

IT'S ADAPTABLE—You can mount the Analyzer almost anywhere and forget it. Nearby operating equipment—motor driven pumps, compressors, etc., can't affect the measurement either by introduction of stray electrical "hash" or through mechanical vibrations. Such immunities make the Analyzer a "natural" for plant use.

IT'S SIMPLE—The Analyzer has no moving parts—no lenses—no mirrors. It's the only single column gas analyzer built. These features make the Analyzer an uncomplicated, ideally practical addition to your process instrumentation.

The infrared specialists in our Application Investigations Lab will be glad to discuss your use of infrared analysis. You can take advantage of this service, without obligation, by answering the questions on our special Infrared Analysis Data Sheet 600-91-ND46(1) mailed on request.

Or, you can learn more about the Infrared Analyzer and its Speedomax® recorder by requesting Demonstrator ND46-91(1), "How the L&N Infrared Gas Analyzer Works," from Leeds & Northrup Co., 4916 Stenton Ave., Phila. 44, Pa.

LEEDS instruments **NORTHRUP** automatic controls • furnaces

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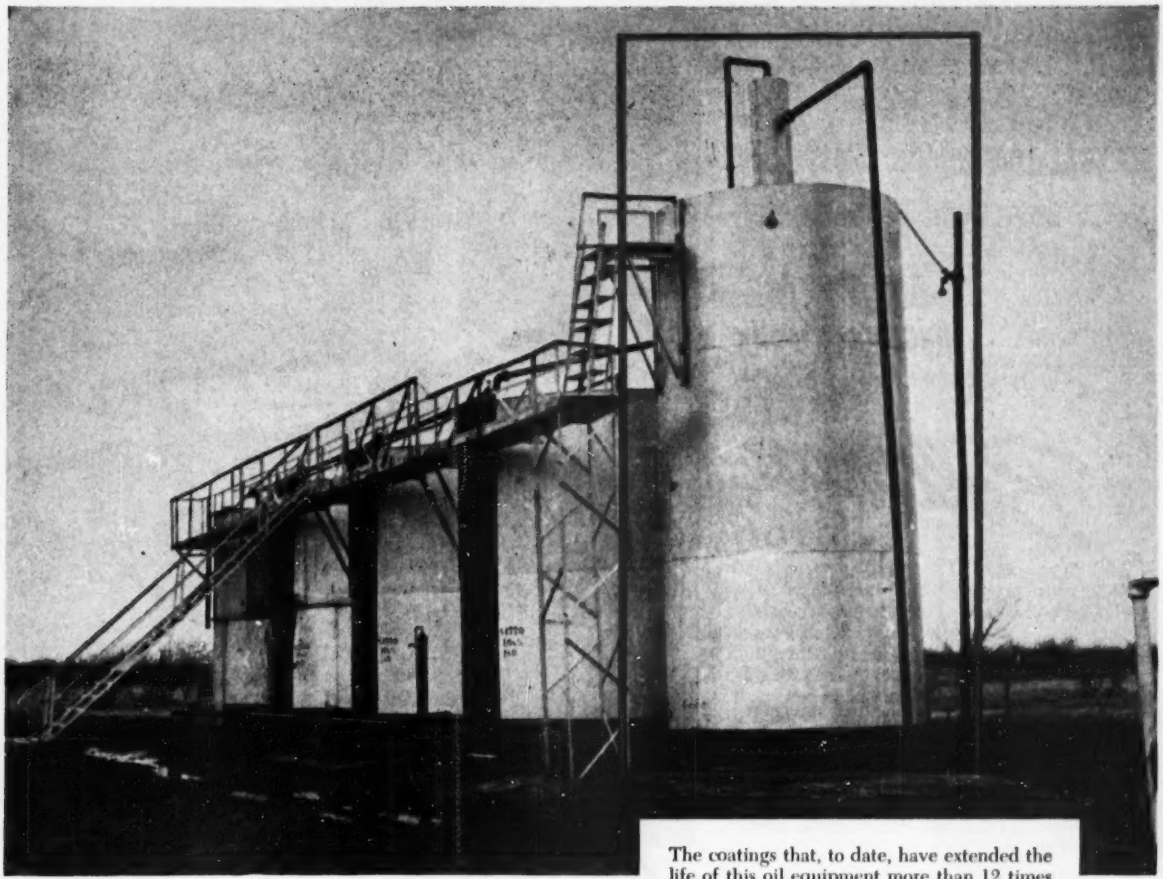

The coatings that, to date, have extended the life of this oil equipment more than 12 times were applied by **Mid-Continent Plastic Co.**, Odessa, Texas.

12 times the service life and still going strong ...that's how the right coating can cut costs

This battery of Texas oil tanks shows a large ¼-in.-steel gunbarrel tank in the foreground. It is used to separate salt water from crude oil. Both the salt and the hydrogen sulphide in the oil are highly corrosive. This gunbarrel tank was installed brand new. Within 30 days a hole appeared in its side. This was patched, and noticeable thin spots reinforced. Only 30 days more and leaking began again. Thus, after two months, two alternatives remained—replace the tank or try protective finishes.

Coatings based on BAKELITE Vinyl Resins were recommended and applied by spray, after sandblasting. That was over two years ago. *No further corrosion trouble has been experienced, and the coating is still in excellent condition.*

Whatever, or wherever your equipment or structures, it can pay *you* to investigate the specialized formulations based on BAKELITE Resins available from many coating suppliers. For a broad picture of their many applications write for a free copy of our booklet "BAKELITE Resin Coatings for the Chemical Industry." Address Dept. **YA-46.**

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RESINS FOR COATINGS
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BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* 30 East 42nd Street, New York 17, N. Y.

How Exon 402-A wipes out corrosion

Exact tolerances previously destroyed by corrosion

...are now kept micrometrically exact with

Boltaron 6200

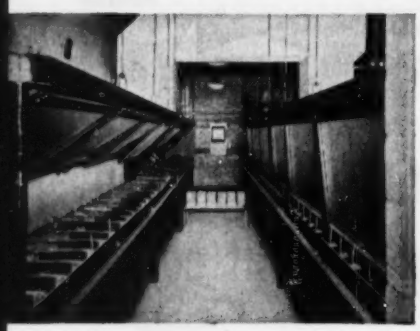
A 2-headed problem faced Norris-Thermador Co. of Los Angeles. They use large rings like stencils to plate copper onto kitchenware. Painfully exact tolerances are mandatory. But the corrosive solutions used ate away the tolerance, ruined rings, skyrocketed costs.

Engineers ransacked industry's resources for one material that could hold tolerance in so corrosive a solution. They found it in Boltaron 6200.

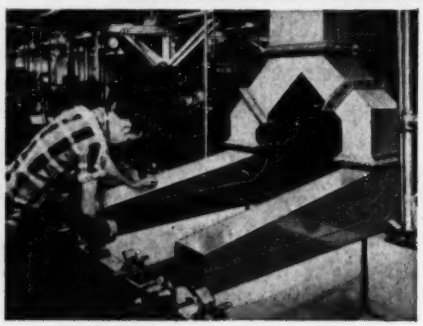
After a year, Boltaron 6200 rings show no sign of corrosion. Replacement costs? Wiped out!

Installation by Horace Blackman Co.

Photographs courtesy H. N. Hartwell & Son, Inc., Boston 16, Mass.

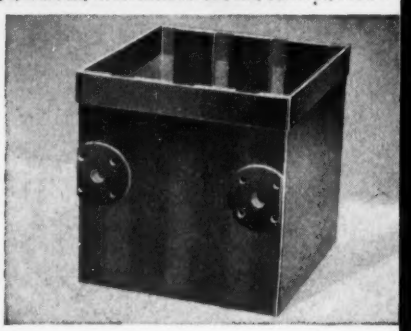


★ For 18 months, sulfuric acid fumes have failed to corrode a Boltaron fume removal system at Electric Storage Battery Company, Fairfield, Conn.



★ Maintenance costs were wiped out at Cannon Electric Co., Los Angeles. A metal-corroding solution of 33% nitric, 33% sulfuric acid and 33% fluoride salts has left Boltaron ducts and tanks unmarked for a year.

Installation by Horace Blackman Co.



★ Eastman Kodak Co., Rochester, reports that Boltaron 6200 remained completely uncorroded by ferricyanide after 3 years, when no other material lasted 3 months.

Installation by Industrial Plastic Fabricators, Inc.

New rigid, extremely versatile, light weight materials are making corrosion a memory in industry all over America. These unplasticized polyvinyl chlorides are typified by Boltaron 6200.

Firestone's Exon 402-A resin meets Boltaron's exacting specifications —best assurance of uniform results under the most corrosive conditions.

These materials can be welded, sawed, sheared, stamped, milled, molded, planed, drilled, embossed, rolled and cemented—on conventional woodworking or metalworking equipment.

For details that will interest you in particular, call or write:

Firestone

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Chemical Sales Division

FIRESTONE PLASTICS COMPANY, DPT. 28B POTTSTOWN, PENNSYLVANIA
A DIVISION OF THE FIRESTONE TIRE & RUBBER CO.

NOTE: Firestone supplies the resin only, does not manufacture the end product.

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by the industries it serves

Our sincere apologies to the many other leading industries space prevents including.

For information on any question that relates to ground water development, write . . .

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Tracing design on glass cloth from metal loft at A. O. Smith Corp., Rochester Works.

Valuable originals protected against wear and tear

At the A. O. Smith Corp.'s Rochester (N.Y.) Works, large drawings are made exactly to scale on glass cloth. Since these drawings often cost several hundred dollars each, A. O. Smith naturally does not wish to expose them to possible damage during print-making and to the wear and tear of excessive handling. Instead, they use intermediates made on Kodagraph Autopositive Paper.

Costing but a few cents a square foot, Autopositive produces positive photographic prints directly from the original drawings – without a negative step or darkroom handling. It can be exposed in standard print-making equipment and processed in standard photographic solutions. (A. O. Smith uses a vacuum-frame printer, which accommodates drawings up to 8 x 4 feet in size.)

No worries with Autopositive intermediates – they turn out sharp, legible shop prints time after time. Their dense photographic black lines do not smudge or smear. And they can be run at uniform, practical speeds in the company's direct-process machine.

In addition, A. O. Smith keeps an "Autopositive File" showing the history of changes in all their drawings. Before each revision, an Autopositive intermediate is made. Later on, direct-process prints showing the complete story of each design can be made from the intermediates as needed.

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction

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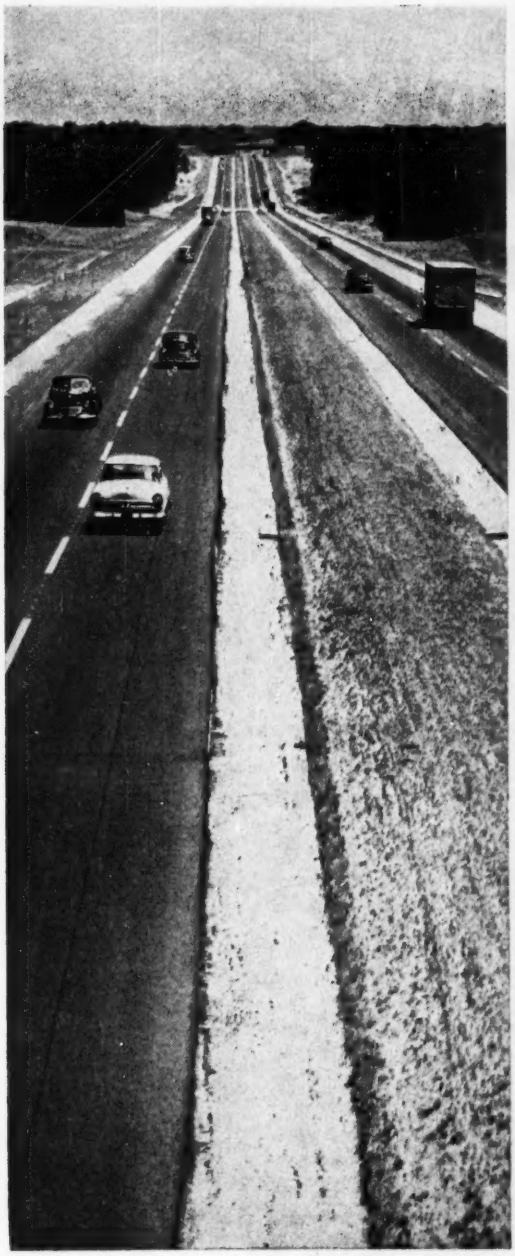
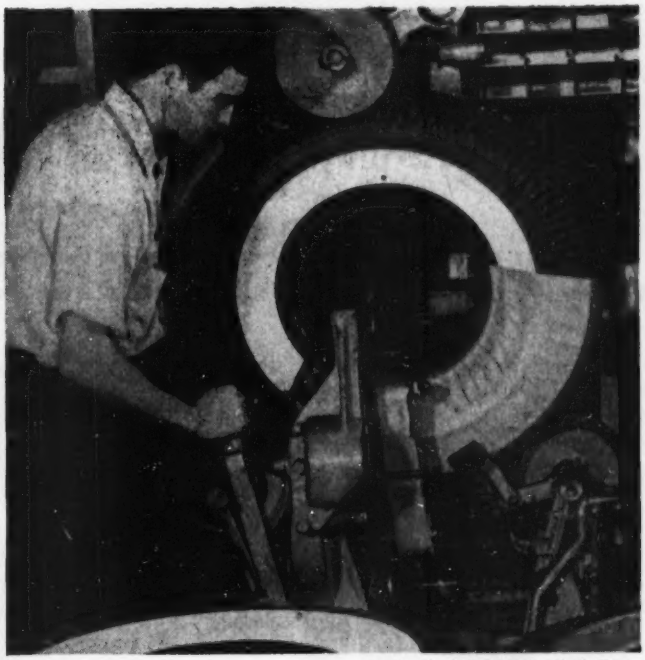
Kodak



Motor Oil and Gasoline (Additives)



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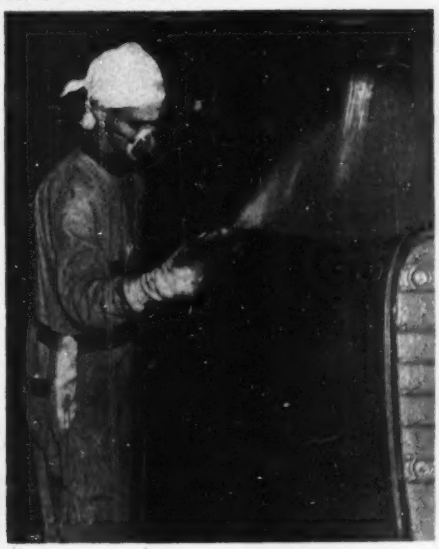

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It's that easy...with a minimum of manual labor. And G-W Drum Dumpers can be made in various heights to suit particular installations—and with specially-designed carriages for particular sizes and types of drums or similar containers. Although sturdily built, they're easily moved on rugged rubber-wheel casters.

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Chempump....

a centrifugal that can't possibly leak

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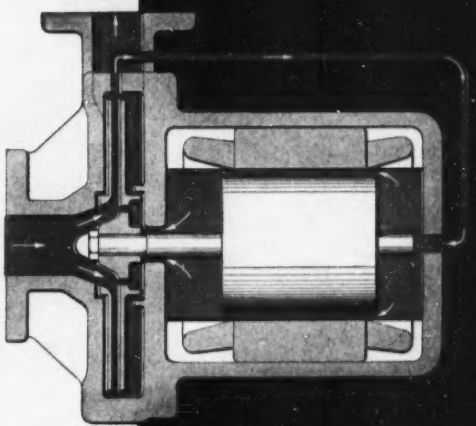

designed to eliminate most of your pumping problems by eliminating their source.

There are no mechanical seals . . . no stuffing box . . . no lubrication! The pump is totally enclosed, motor and all!

There's no leakage or contamination of fluids . . . completely contains expensive, toxic, or corrosive fluids . . . protects plant and personnel.

The combined rotor and impeller assembly, actuated by a radial magnetic drive, is the *only* moving part! Fluids circulate through the rotor chamber of the motor. The stator is isolated from the fluid by a corrosion-resistant, non-magnetic alloy cylinder. And the rotor is hermetically sealed.

Thousands of installations over a 6-year period of field experience have resulted in the Chempump design. Users throughout industry are now enjoying the benefits of this design, in hundreds of successful installations.

Chempump is available in from ⅛ up to 3 horsepower. Capacity range is from 0 to 180 gallons per minute. Heads from 3 to 90 feet. Wide selection of alloys available. Prices start at approximately $100.00.

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Whatever your needs... drive chain, conveyor and elevator chain, complete elevators, belt conveyors, feeders, roller bearings, buckets or sprockets, you'll relieve those production pains by looking to Chain Belt. See your local Field Sales Engineer or write direct to Chain Belt Company, 4648 W. Greenfield Ave., Milwaukee 1, Wis.

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GE picks waterproof, fireproof FOAMGLAS to insulate Atomic Sphere

The G. E. Atomic Sphere is 26 times larger than any previously built. It has a surface area of 159,000 sq. ft. Inset photo shows how easily the lightweight FOAMGLAS blocks were handled by the workmen. This rigid insulation was more than strong enough to support their weight, yet easy for them to cut and shape.

General Electric Company engineers picked waterproof, fireproof FOAMGLAS to insulate the world's largest steel sphere. The Knolls Atomic Power Laboratory, Schenectady, which G.E. operates for the A.E.C., will use the sphere to test the prototype of an atomic powered submarine for the U.S. Navy. *Constant* control of temperatures is a must for worker comfort. Therefore, to insulate the sphere FOAMGLAS was a must because its sealed glass cells can't absorb the moisture that cuts efficiency of other insulations. This guarantees GE *constant, long-lasting* insulating protection . . . and fireproof FOAMGLAS reduces external fire hazards which might damage the sphere.

Why not discover how FOAMGLAS can benefit *you?* Send today for a sample and your choice of booklets describing the use of FOAMGLAS to insulate: 1) piping, tanks and other equipment; 2) cold storage space; or 3) normal temperature buildings. Write, indicating your specific interest.

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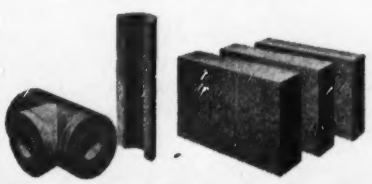

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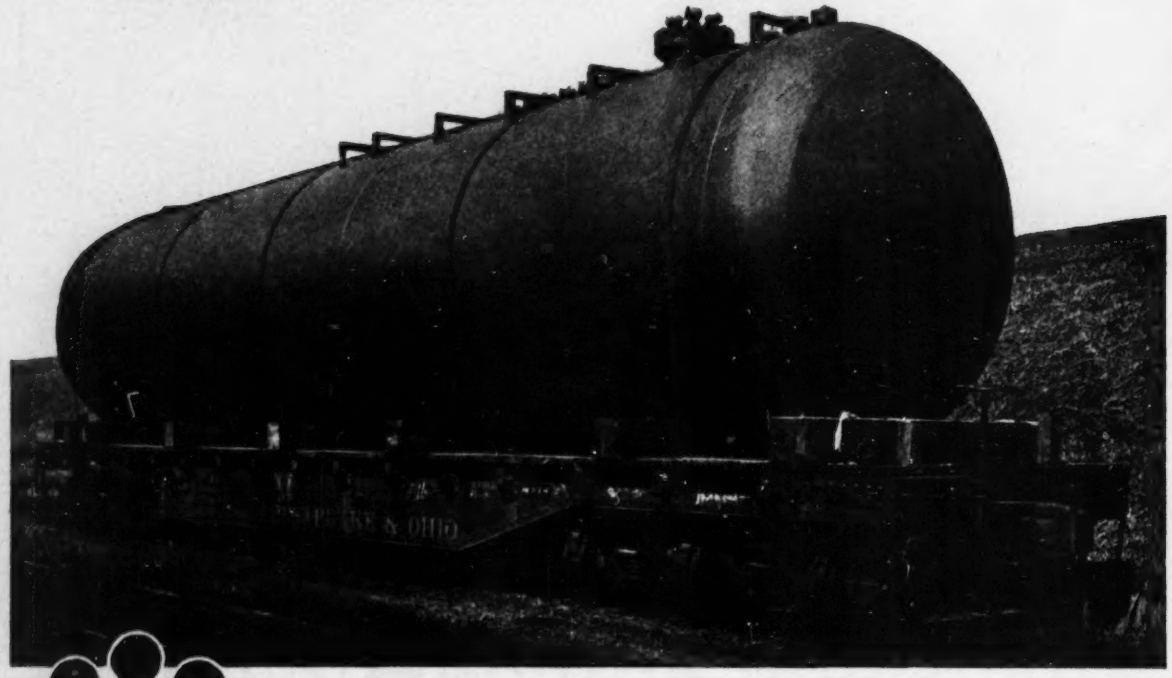
Pittsburgh Corning also makes PC Glass Blocks

One of six 51-foot liquid chlorine horizontal storage tanks built and tested by Newport News to meet A.S.M.E. Code requirements. This pressure vessel was welded by Union melt machines. Pressure vessels undergo stress-relieving treatment in our ovens.



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Units of large dimension are readily constructed by Newport News in a 225-acre plant that includes five huge, fully equipped machine shops, drop forging and die facilities, heat treating ovens, and acres of brass, iron and steel foundries.

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Screwed-in Cap, screwed end Swing Check Valve for 200 W. P.
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HERE ARE shown a few Powell Monel Metal and Nickel Valves in stock, that can be shipped immediately on receipt of order. They are made with screwed or flanged ends, for 150 and 200 W. P. at 500° F. Sizes range from ¼" to 30".

Solid or double wedges for Gate Valves are interchangeable, precision-fitted, and accurately guided throughout their entire travel.

These valves conform to latest A.S.A. and M.S.S. Standards. End flanges will be furnished with plain faces. Raised, ring joint, male and female, or tongue and groove faces can be supplied on special order.

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*Registered trade name of The International Nickel Co.

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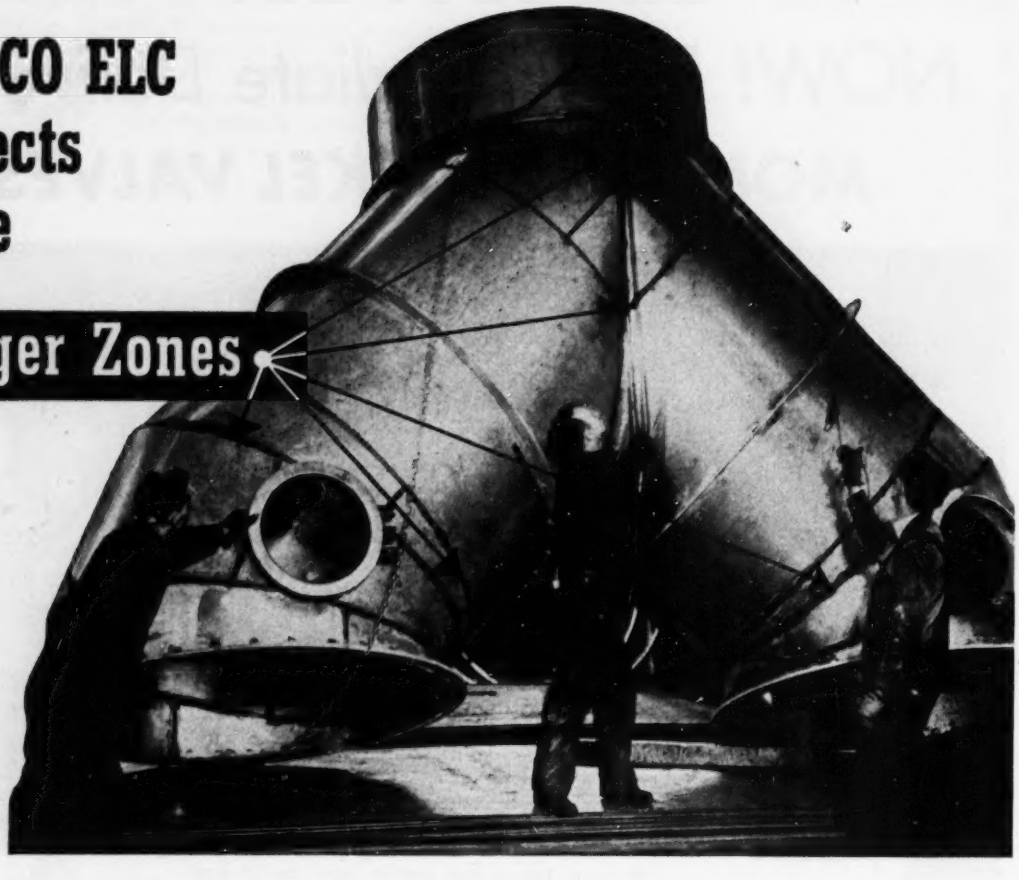
ARMCO ELC protects these Danger Zones



There are no corrosion "danger zones" alongside welds when you use Armco ELC Stainless Steels. ELC means "extra-low carbon"—a maximum of only 0.03 per cent, too little to cause harmful carbide precipitation adjacent to welds during the welding operation.

Moreover, Armco 18-8 ELC (Type 304L) and Armco 18-12 Mo ELC (Type 316L) are lower in cost than their corresponding stabilized types. Yet the Armco ELC grades are equally resistant to intergranular corrosion in the as-welded condition in service at temperatures below 800 F.

No Anneal Needed

For severely corrosive service, non-stabilized types of stainless steel like 304 and 316 must be annealed after welding. This is to dissolve the chromium carbides precipitated during welding. Such an anneal is not needed with the ELC types. This makes the Armco ELC grades ideal for field assemblies and repairs.

Write for Booklet

If you are not already acquainted with the Armco ELC Stainless Steels, why not fill out and mail the attached coupon. We will send you a copy of the booklet, "Armco's ELC Stainless Steels." Or, if you want complete information on Armco Stainless Steel sheets, strip, plates, bars and wire, ask for the catalog, "Armco Stainless Steels."

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Why is this brick worth $1.70?

Suppose you put a muffle arch of these $1.70 brick in a furnace and — as a direct result — *doubled productive capacity*. Suppose you put them in the floor of another and it *lasted 50 times longer*. Suppose you put them in the hearth of a third and *eliminated 30 days downtime* in one year. Then at $1.70 apiece these brick would be a terrific buy. And are. Because these figures come from real, live companies! Companies that replaced ordinary refractories with CARBORUNDUM's super refractories!

Granted, you can't always get such spectacular results. But you usually get a combination of benefits. For example, by lasting longer, CARBORUNDUM's refractories automatically cut costly downtime losses . . . and maintenance expense . . . and labor. And by using heat more efficiently, you not only increase production . . . but cut fuel costs . . . and cut rejects. In short, their value is more — much more — than just to resist heat.

So if you could use a material that is far harder than metals . . . or one that conducts heat nearly as rapidly as chrome-nickel steel . . . or another that insulates well at temperatures above 3000 F — we have them. These "man-made minerals" range from a ceramic fiber (looks like cotton), to a superdense refractory that's cast, like a metal. And our engineers can show you how to combine these materials to exploit their complete range of properties.

WHY NOT CHECK UP? It's smart to at least know what super refractories *can do*. This coupon is your private introduction.

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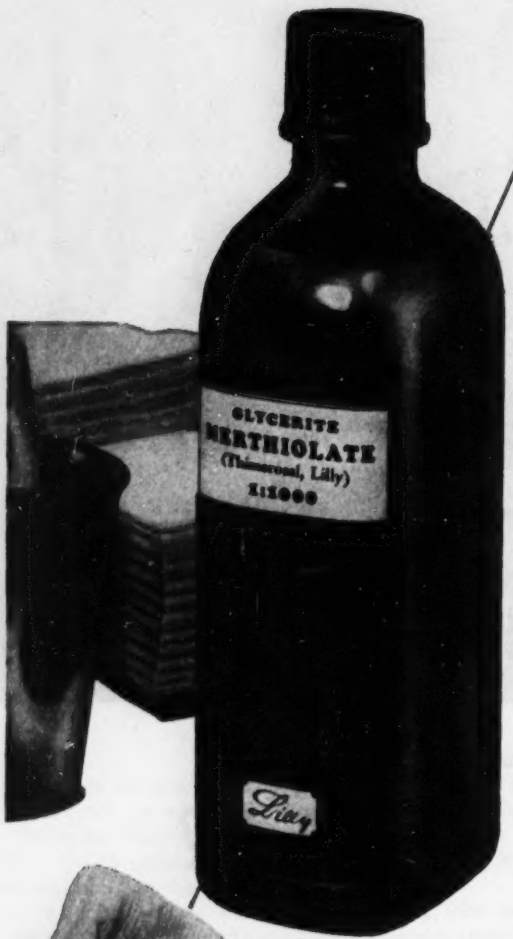
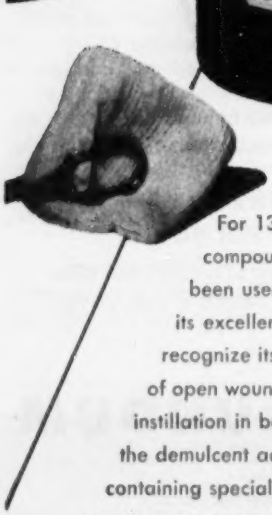
since 1941 / Glycerine is the Demulcent



In antiseptics and other pharmaceutical preparations which come in contact with delicate body tissues, demulcent action is often important. Pharmaceutical manufacturers choose U.S.P. Glycerine because it is an excellent demulcent—and because it can contribute other valuable properties too.

Versatile Glycerine can serve not only as a demulcent, but also as a solvent, preservative, plasticizer, lubricant or emollient. Druggists are reported to use Glycerine in one out of four prescriptions and in more than 50% of the liquid medications compounded. In the drug field, as in many others, *nothing takes the place of Glycerine.*

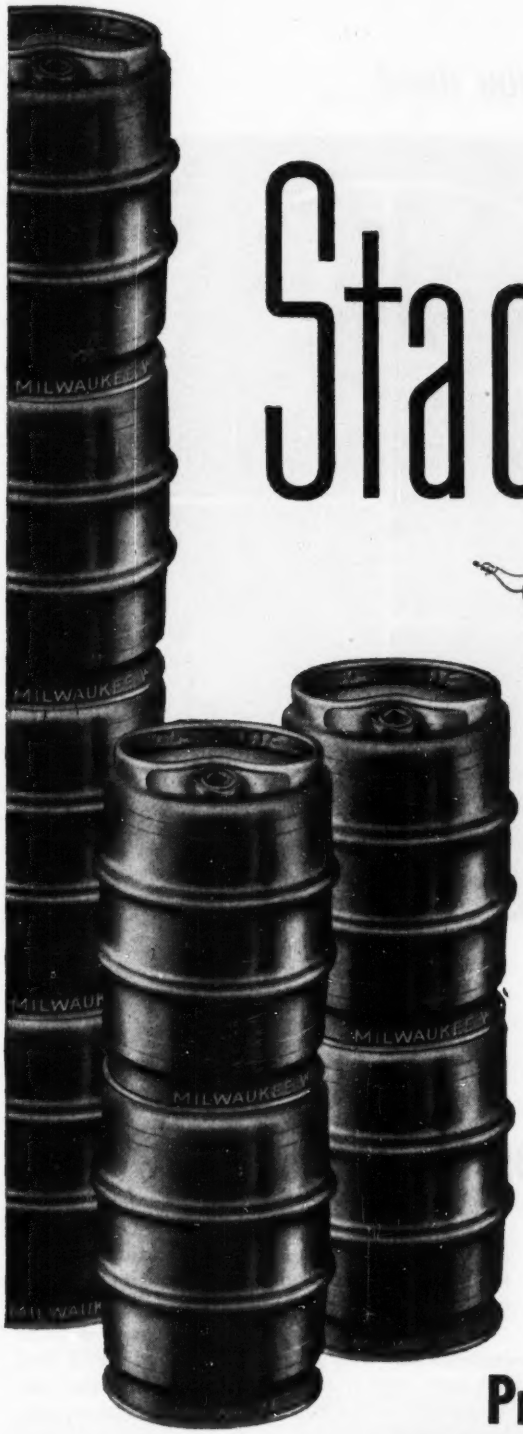
Write for the informative, 16-page booklet, "Why Glycerine for Drugs and Cosmetics?" It describes Glycerine's properties and applications and is yours for the asking from Glycerine Producers' Association, 295 Madison Avenue, New York 17, N. Y.



For 13 years, Glycerite Merthiolate* compounded by Eli Lilly and Company has been used by the medical profession for its excellent antiseptic properties. Physicians recognize its advantages in the irrigation of open wounds, in making wet dressings, and for instillation in body cavities—applications where the demulcent action of this Glycerine-containing specialty is particularly desirable.

*'Merthiolate' (Thimerosal, Lilly)

Nothing takes the place of Glycerine



Stack 'em up!

...and save storage space

Here's the lightweight, stainless steel acid container that builds a safe, compact stack—saves warehouse space and handling time for you. Bottom foot ring of the 15½-gallon Hackney Chemical Container fits snugly over top ring of lower barrel.

Designed with easy-to-grasp, full curled foot rings for safe, one-man handling and convenient pouring. Your name can be embossed on the bottom foot ring. Low tare weight reduces transportation costs. Stainless Steel protects your dangerous or perishable chemical products—eliminates breakage losses.

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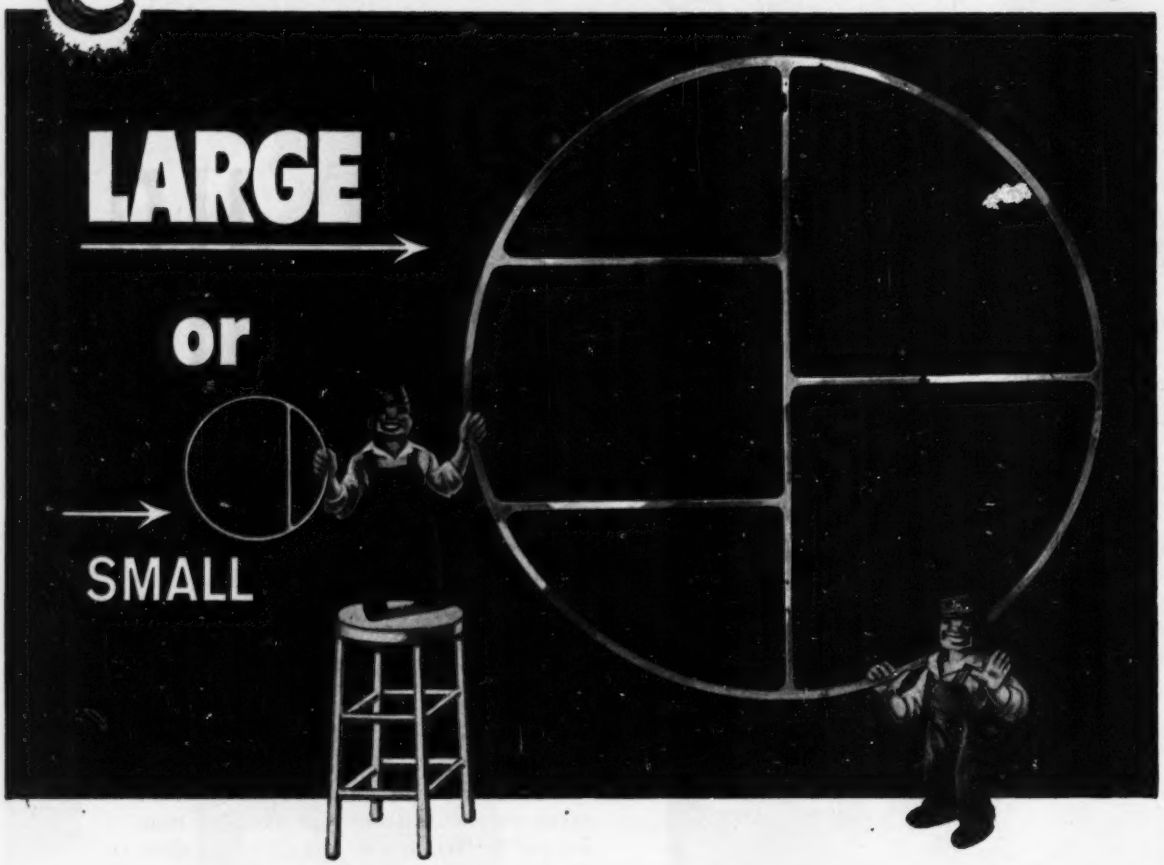

...Goetze Heat Exchanger Gaskets are precision-made for longer service

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And because they're *precision-made*, you'll find these better gaskets provide the effective sealing and longer life that make them actually cost less in the long run. Each gasket is carefully constructed in every detail to assure accuracy of fit . . . to provide ample lap widths and uniform rib widths . . . and to prevent trouble-making wrinkles or cracks on the corners.

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Johns-Manville *Goetze* GASKETS

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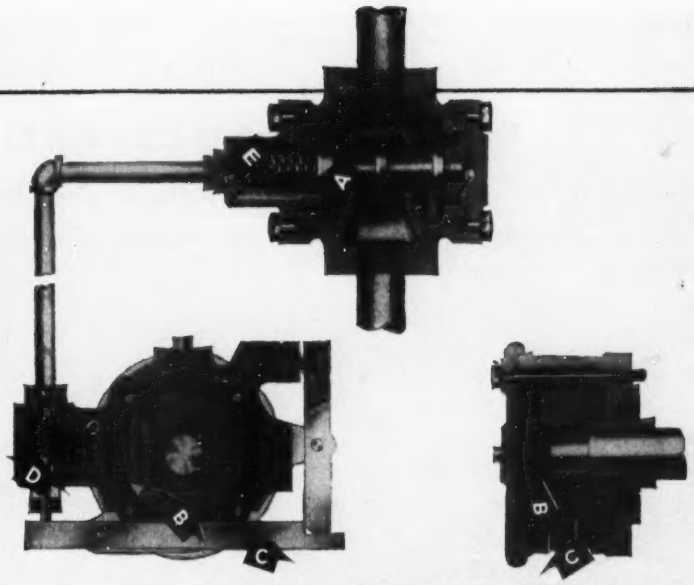
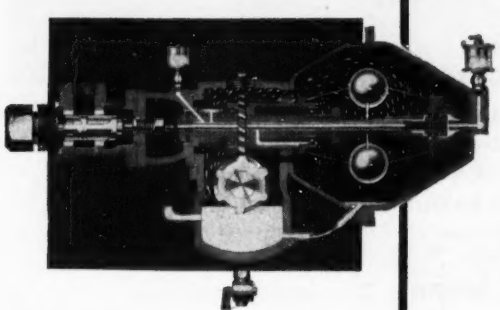
Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When turbine is operating, Lever C is horizontal, Pilot Valve D closed, and Valve A held open by Spring E. When excess speed is reached, centrifugal force throws Weight B against Lever C, opening Pilot Valve D. This relieves the pressure back of Valve A, unbalancing and closing it immediately, compressing Spring E and shutting off the steam supply to the turbine. When Lever C is manually reset, Pilot Valve D closes, allowing pressure to build up back of Valve A and thus restoring the balance. Spring E then opens Valve A, admitting steam to turbine.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

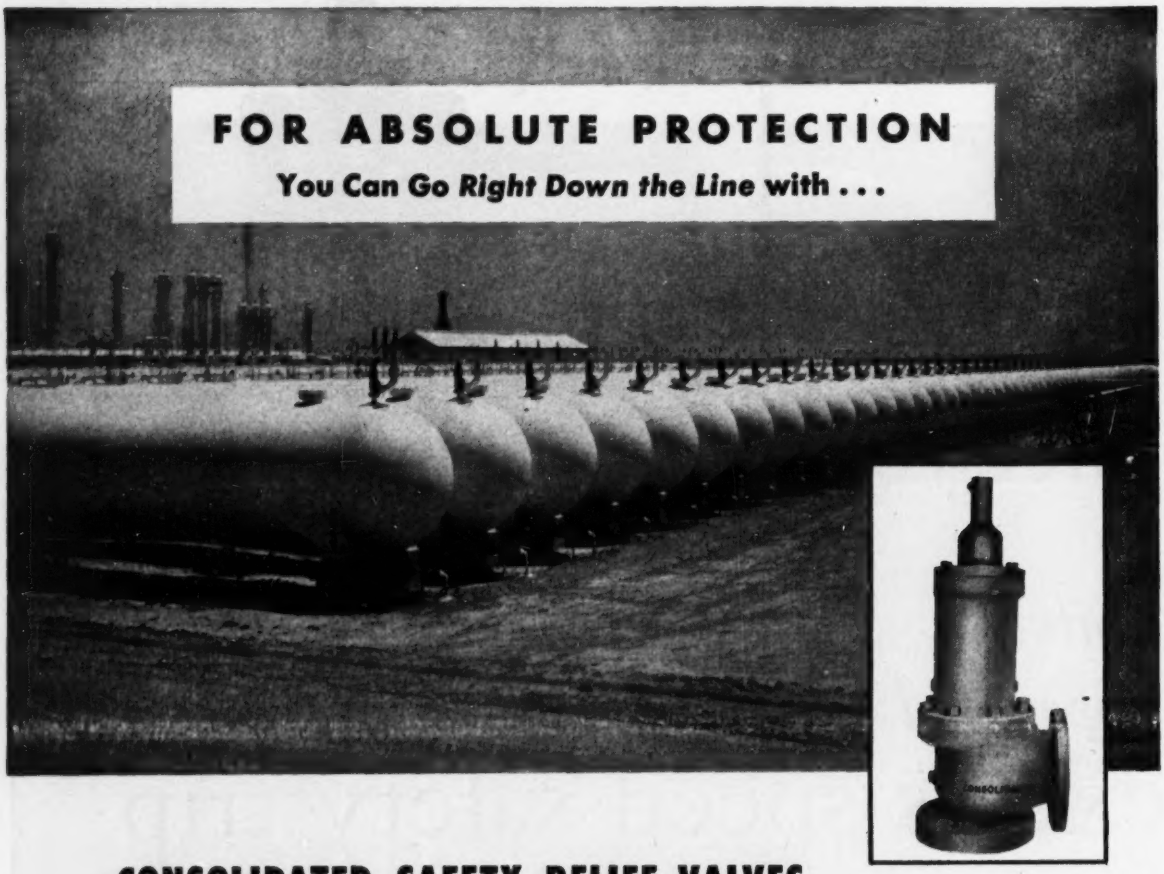
CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION, 228 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES



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COMPLETE PROTECTION for personnel, property and equipment rates top priority in safety engineering wherever industry must confine gases, vapors and liquids in unfired pressure vessels. That is why Consolidated Safety Relief Valves are such a common sight on processing facilities, pipelines, pumps and storage tanks.

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SIMPLE DESIGN — 25% fewer parts than ordinary safety valves — means that Consolidated Safety Relief Valves minimize maintenance and standardization problems and save in long-life operation.

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for an efficient film production line

The three bulletins illustrated describe the major components of the processing setup blueprinted above. They contain details of the latest developments in processing methods and equipment, as pioneered by Farrel-Birmingham in the last few years, as well as illustrations, general specifications, information on related equipment and other pertinent data.

The processing setup is one of a number developed by Farrel-Birmingham to synchronize the progressive steps in the production of plastic film, sheet and coatings. These matched production units have given such satisfactory service that they have become generally accepted as standard equipment. For individual requirements, demanding greater or lesser output, larger or smaller machines with matched capacities are available.

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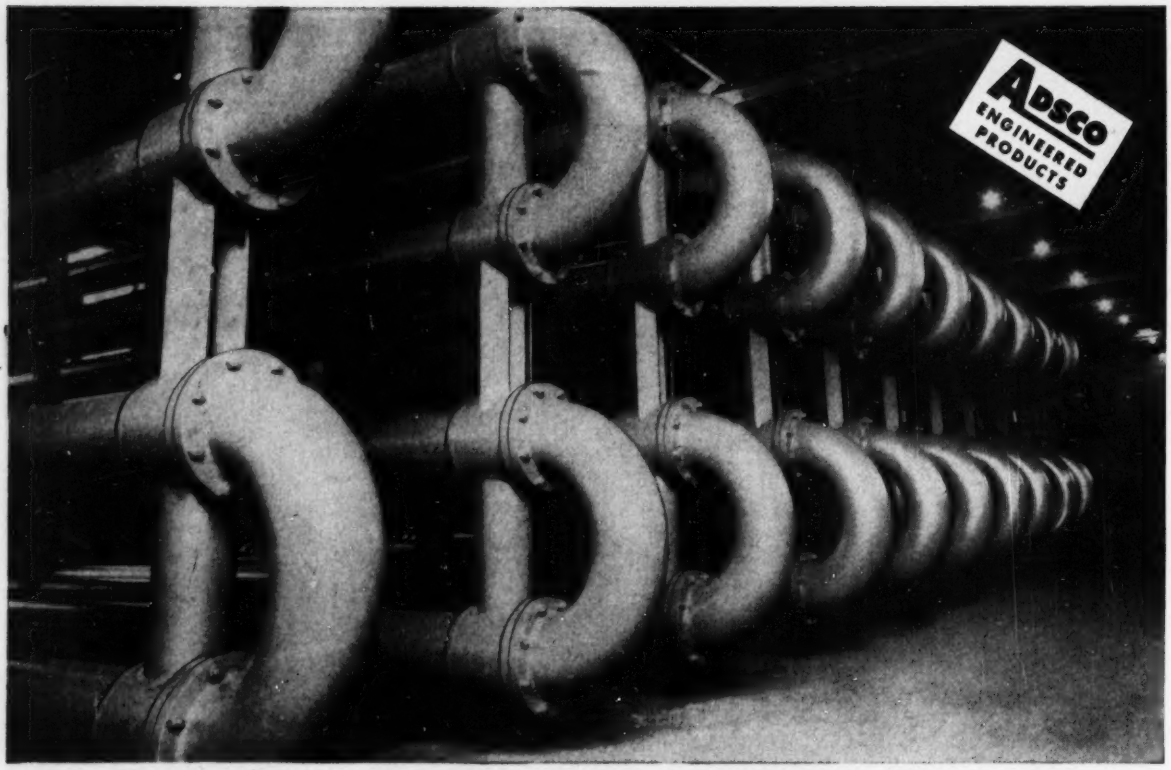

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High efficiency in the causticizing department of a new cellulose plant erected by one of the largest concerns in the country is achieved by these ADSCO Heat Exchangers. In the process, one liquid must be cooled, the other heated. The ADSCO exchanger thus accomplishes two jobs in one. To achieve the small terminal temperature differences desired, counterflow design, with the exchangers in series, was necessary. Straight-tube, fixed-tube-sheet construction was selected as the most economical design. Liquid in the tubes passes from one tube bundle to another through the 180° elbows at the ends; liquid in the shells passes from shell to shell through the short vertical connecting pipes. Hot corrosive liquor holds no terror for these exchangers because tubes and tube sheets are of stainless steel . . . These 40 exchangers are evidence of the contribution which ADSCO can make to the sound engineering required in chemical and petroleum processing plants. . . . Your ADSCO representative invites inquiries.

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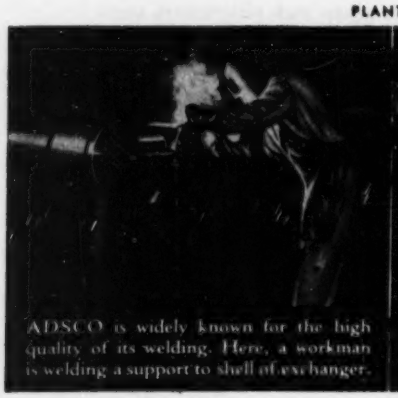
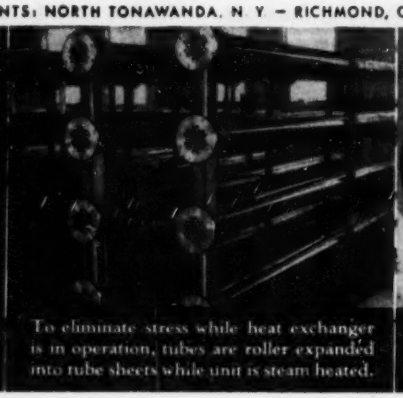
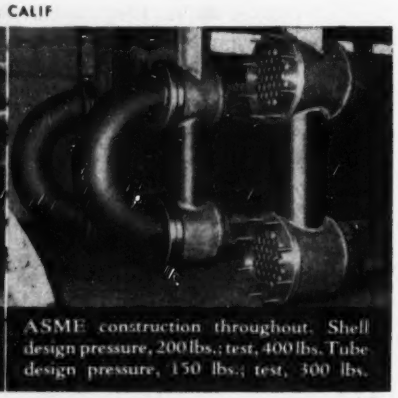


ADSCO is widely known for the high quality of its welding. Here, a workman is welding a support to shell of exchanger.



To eliminate stress while heat exchanger is in operation, tubes are roller expanded into tube sheets while unit is steam heated.



ASME construction throughout. Shell design pressure, 200 lbs.; test, 400 lbs. Tube design pressure, 150 lbs.; test, 300 lbs.

a new miniature indicator!

Available with:

MEASURED VARIABLE → AIR-PILOT → COPPER TUBING

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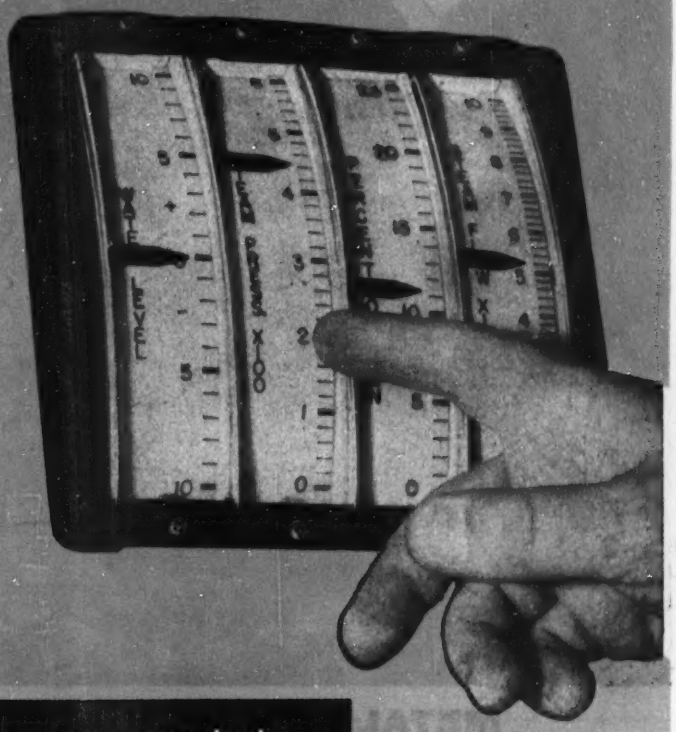

removable units—interior illumination

easy to read—5 inch scale, no parallax

easy correlation of related functions

easy zero check from the front

HAYS Miniature Indicators

This miniature instrument is especially suited for remote indication of such variables as pressure, draft, flow or level.

The scale is only 5 inches long — easy to read — internally illuminated. Choice of pneumatic or electric transmission.

Also available is the Hays direct reading miniature gage for indicating *pressures* of fluids (steam, water, gas, oil, etc.) directly.

Gages are arranged for flush or semi-flush mounting. Either a yoke mounting, for as many as 12 units, or a keyhole clamp mounting for individual units can be provided.

Write today for full information on the Hays Miniature Indicator Bulletin 52-1075-223.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
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MICHIGAN CITY 9 INDIANA

METALLIC SODIUM... easy to handle

Production men are learning that Sodium can be handled on a commercial scale, using the same degree of care and caution demanded by most chemicals. As a result, more and more research and development ideas for the use of Sodium as a reaction tool are being put into plant operation.

In 1953, a quarter of a billion pounds of Sodium Metal were produced for industrial consumption: 137 million pounds went into Tetraethyl Lead; 40-50 million for Fatty Alcohols; about 45 million into Sodium Cyanide; 7-10 million into Sodium Peroxide; about 4 million into Sodium Hydride Descaling of steel; and 4 million for insecticides, dyes, drugs, alkoxide preparation, specialty chemicals, and a number of miscellaneous uses.

Sodium is supplied in tank cars, in steel drums (bricks or solid cast) or small brick in 20 lb. pails. It may be employed as a molten liquid, as bricks, as a dispersion in an inert hydrocarbon or as a coating on free flowing inert solid particles. These last two forms, developed by our research division, are broadening the industrial uses for this versatile metal.

U.S.I. offers complete assistance to research, development and production staffs. We will help you to prepare dispersions and powders and to handle all forms safely. We will aid you on sodium chemistry and in training operating personnel. We will advise on equipment requirements. Booklets are available on all technical phases.

Let us show you how to use Metallic Sodium in your plant.

U.S.I.

Metallic Sodium is manufactured by National Distillers Chemical Co. at Ashtabula, Ohio and sold by:

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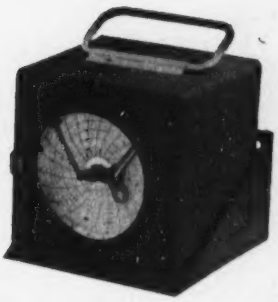

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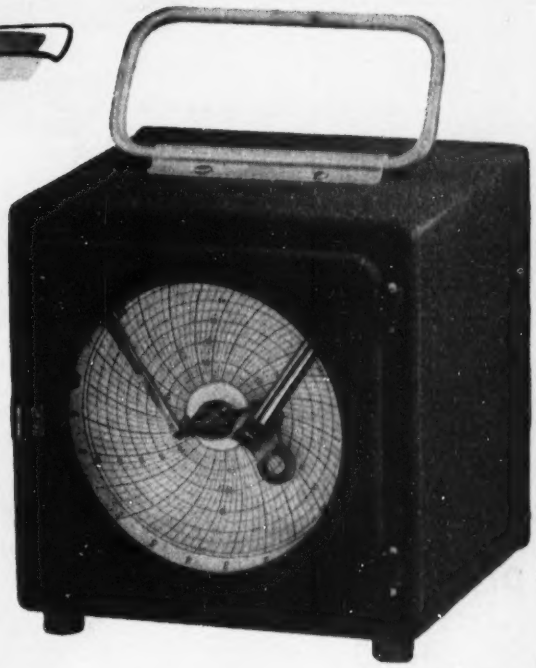
miniature
Electrical Recorder

EXTREME COMPACTNESS...CORMAG® SELF-SHIELDING MECHANISM... A-C AND D-C MODELS



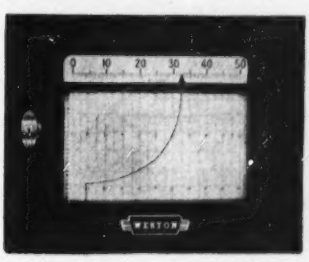
Employing the Weston CORMAG mechanism, this new recorder combines a high degree of shielding with new compactness and light weight. For example, the magnetic field created by a conductor carrying 15,000 amperes at a distance of 3 feet would cause a temporary error of less than 1 per cent. Over-all size is only 6¾" x 6¼" x 7" deep; chart size 4" dia.; weight only 1½ lbs.

It's the ideal instrument for recording ampere-hour demand—checking overloads or unbalanced conditions—monitoring radio detectors—recording current and duration in electroplating and metal refining—recording speeds—making life tests on batteries, lamps, etc.

Available in required ranges for A-C or D-C voltage or current measurement needs. Also furnished with bracket for wall mounting; and with flange case for flush panel mounting. Bulletin available giving complete specifications and prices . . . WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey. 7553

WESTON SIMPLIFIED RECORDING POTENTIOMETER

Sets a new standard for sound, simplified design—for simplicity and economy of maintenance—for sustained high accuracy and dependability. Ranges changed simply by inserting required range standards. Chart speeds changed by simple screwdriver adjustment. All features described in bulletin. Send for your copy.



WESTON *Instruments*

these properties make

PFIZER FUMARIC ACID

ideal for alkyd resins, rosin adducts, polyesters

● As a prime raw material for resin preparation, Pfizer Fumaric Acid has three outstanding properties.

Because it is *non-hygroscopic*, it is easy to handle...does not cake or lump. And toxicity studies have shown Fumaric to be even *less toxic* than some food grade acids. This means extra precautions in handling are unnecessary.

It is *non-corrosive*. Resin producing equipment will be unaffected by Pfizer Fumaric Acid.

For more data about Pfizer Fumaric Acid, write for Technical Bulletin No. 46.

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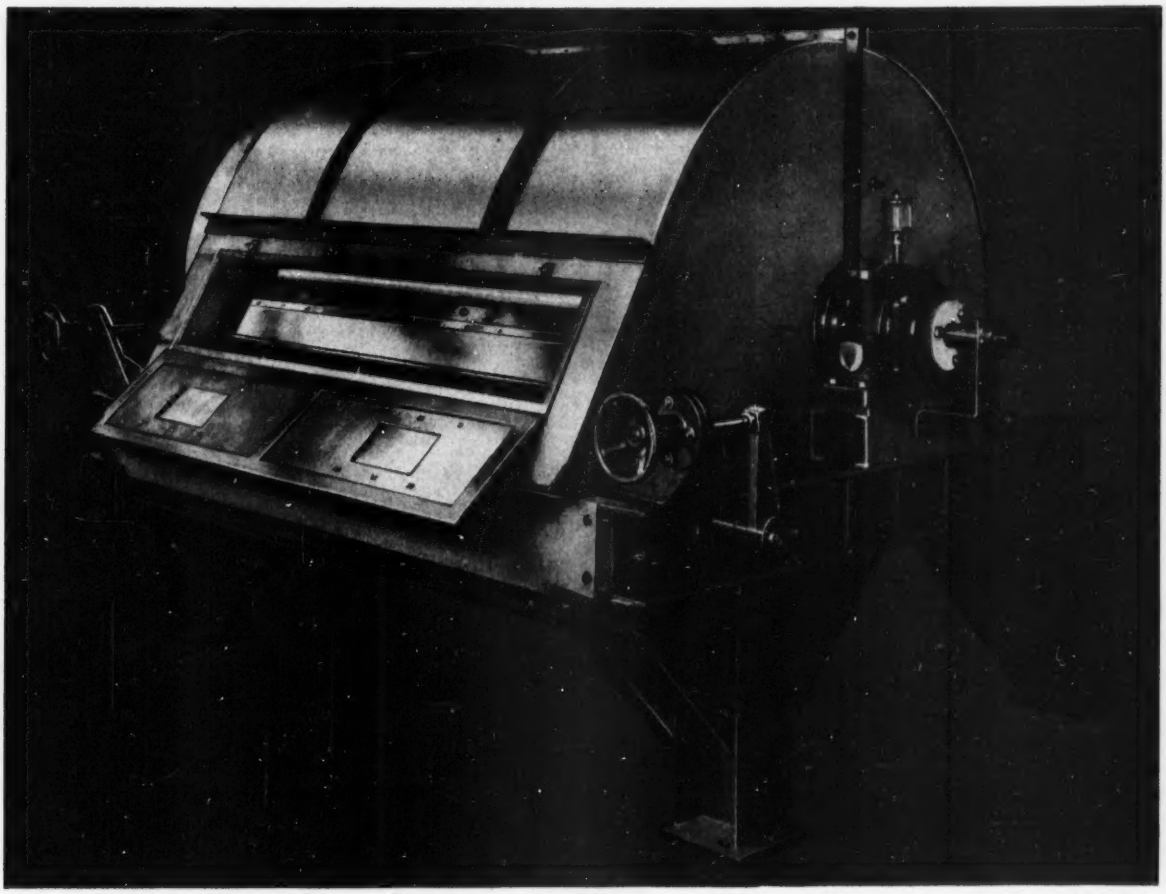

Buflovak Flakers provide continuous operation ... large capacity ... finished product ready for end use

Send for your copy of Catalog 352 to get complete information about Buflovak *Flakers.*

These flakers are used extensively in the chemical industry for producing a flaked or granular material from a variety of products. The molten liquid is applied to a revolving drum, is quickly cooled and continuously removed by a stationary knife. This process offers continuous operation, high capacity and finished product free from lumps.

Sounds simple and easy, doesn't it? But the smooth, efficient operation of *Buflovak* Flakers throughout the chemical industry is often the result of careful pre-testing in the Pilot Plant of our *Buflovak* Research and Testing Laboratory.

What equipment is required for the safe processing of toxic or corrosive materials? What are the most effective cooling methods for products of low or high melting point, and all the products in between? What other modifications may be required for the most efficient processing of your product?

All of these questions can be answered by *Buflovak* engineers, who have an extensive knowledge of processing methods . . . plus the facilities for pre-testing equipment and processes, under production conditions, in our completely equipped Pilot Plant.

These facilities are always available to help you with any flaking problem.

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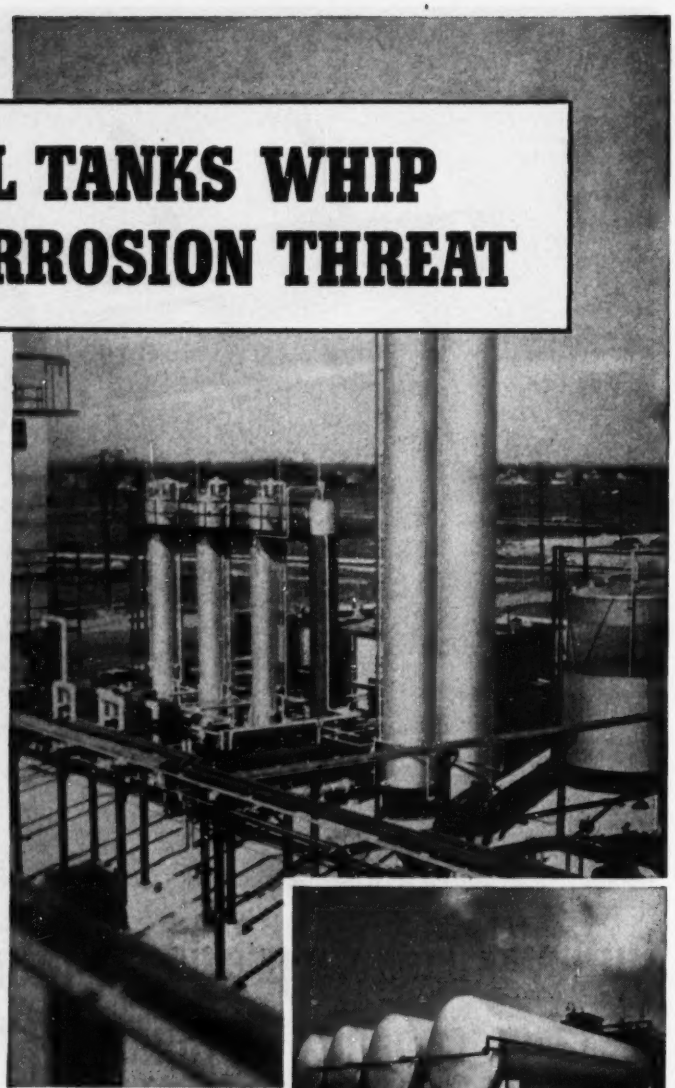
BUFLOVAK PRODUCTS: evaporators • dryers (atmospheric and vacuum) • solvent recovery and distillation equipment • chemical plant equipment • food processing equipment • kettles • fabricated processing equipment • vulcanizers . . . plus a complete Pilot Plant for pre-testing processes and products.

CLAD STEEL TANKS WHIP CHEMICAL CORROSION THREAT

A critical corrosion problem faced this chemical producer. In a plant that can process up to 100 million pounds of fats and oils annually, unsaturated acids and moisture would cause fatty acids to attack iron during storage. Presence of iron salts would threaten instability and as little as 30 to 40 parts of iron per million are enough to darken fatty acids. With lighter colors getting a premium price and output headed for high-grade consumer products, product quality had to be protected. The answer: economical clad steel equipment ended the danger of corrosion during storage, virtually eliminated iron pick-up.

Cooperative planning between the designers and equipment builder solved this problem. Stainless-clad steel was specified for four horizontal feed tanks, two settling tanks and two insulated cone roof storage tanks. Here a light layer of cladding provides the smooth, corrosion-resistant surface of more expensive solid alloy, while the low-cost carbon steel backing gives strength and rigidity. Integral and permanent bonding of cladding and backing prevents seepage of acid to the backing. Smooth contours and joints possible with clad permit easy cleaning and lessen the chances of contamination.

If you are looking for economical product protection, follow the profitable lead of this chemical producer. Call in your equipment builder *early* in your planning of new equipment. Working with your engineers and consultants, he can contribute his skill, know-how, and understanding of your field to give you the low-cost, long-lived clad steel equipment your process demands.



Economical stainless-clad steel tanks guard product quality. They reduce iron pick-up to prevent the discoloration of fatty acids by iron salts.

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or contact Manager, Marketing Service, Lukens Steel Company, 678 Lukens Building, Coatesville, Pennsylvania.

LUKENS CLAD STEELS

STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEELS AVAILABLE ANYWHERE

Reprinted from THE OIL DAILY, February 18, 1953.

Keith Fanshier

FROM NOW ON

TIME WAS in the petroleum industry when volume was the controlling factor in net profit. A volume increase would cure almost anything.

The industry was expanding rapidly. Costs were moderate. By a little ingenuity here and there cost increases could be offset. There was breathing-space.

Times have changed. Costs everywhere have soared, alarmingly. Prices of what the industry has to sell have been held down since wartime by government controls and by probably the most severe competition existing in any industry.

That easy breathing-space no longer is there. Things are tight, all along the line.

• • •

In these circumstances, volume alone is no longer the answer. No more can inherently unsound operations be cured or glossed over by an increase in volume. Larger volume in an unsound situation now will only complicate conditions.

Now even more than ever, for instance, will price wars accomplish nothing—nothing but waste, loss, worry and misery for participants, a reproach upon the industry, and a lower standard of service to public and nation. Also a lower "standard of living" for the oil industry.

The members of this oil industry are in a battle of survival with their costs. A pity of it is that some seem not to recognize the fact, or perhaps even don't know the true meaning of the term: costs.

One thing is sure: cost-consciousness will pay off in this year 1953. That's true of every single operation from the gleam in the eye of a geologist on a mountainside to the cut-off of the hose nozzle in the motorist's tank.

• • •

That should make possible a fair, compensating price structure. That will give this industry a reasonable profit, the public dependable service, the nation a fine contribution to security.

Who says costs are not important? They are this important. Their recognition and recovery is just about the most urgent problem this industry faces this year, and for a long future, if it wants to continue being an industry.

From now on it will take more than volume.

One of the most dramatic sources of economy in modern processing practice is the Ljungstrom Air Preheater. For details, consult The Air Preheater Corporation.

THE AIR PREHEATER CORPORATION

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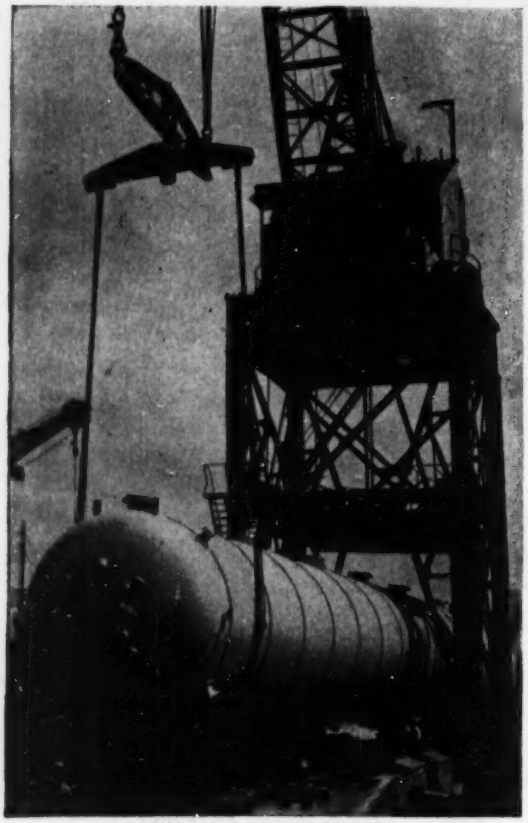
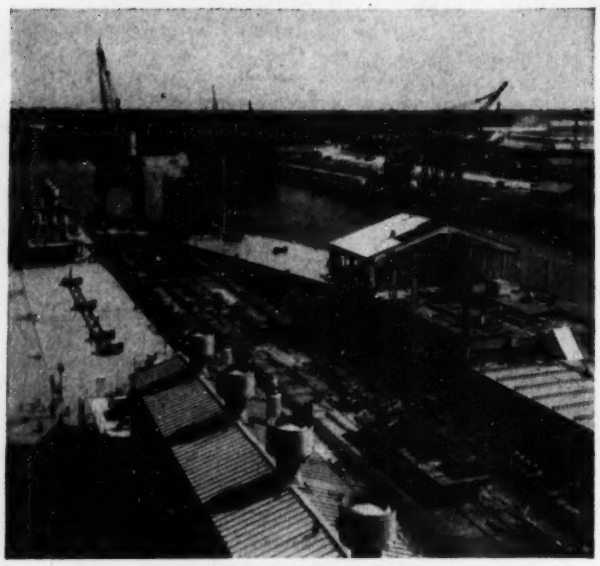
Wherever you burn fuel, you need Ljungstrom

BETHLEHEM at BEAUMONT

Serves The OIL INDUSTRY Ashore and Afloat

Loading of a 171-ton Bubble Tower fabricated at the Beaumont Yard. ▼





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New Construction: Drilling Barges and Tenders. Compressor, Deck, Oil, Supply and Tank Battery Barges. Fixed and Mobile Platforms. Propane, Anhydrous Ammonia, Caustic Soda, Molten Sulphur and Gasoline Barges. Tankers. Freighters.

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Fabrication: Storage Tanks. Refinery Vessels. Bubble Towers. Surge Tanks. Pressure Vessels. Heat Exchanger Shells. Stacks. Distilling Units. Agitators. Separators. Dehydrators. Floating Roofs. Gas and Liquid Pipe Lines.

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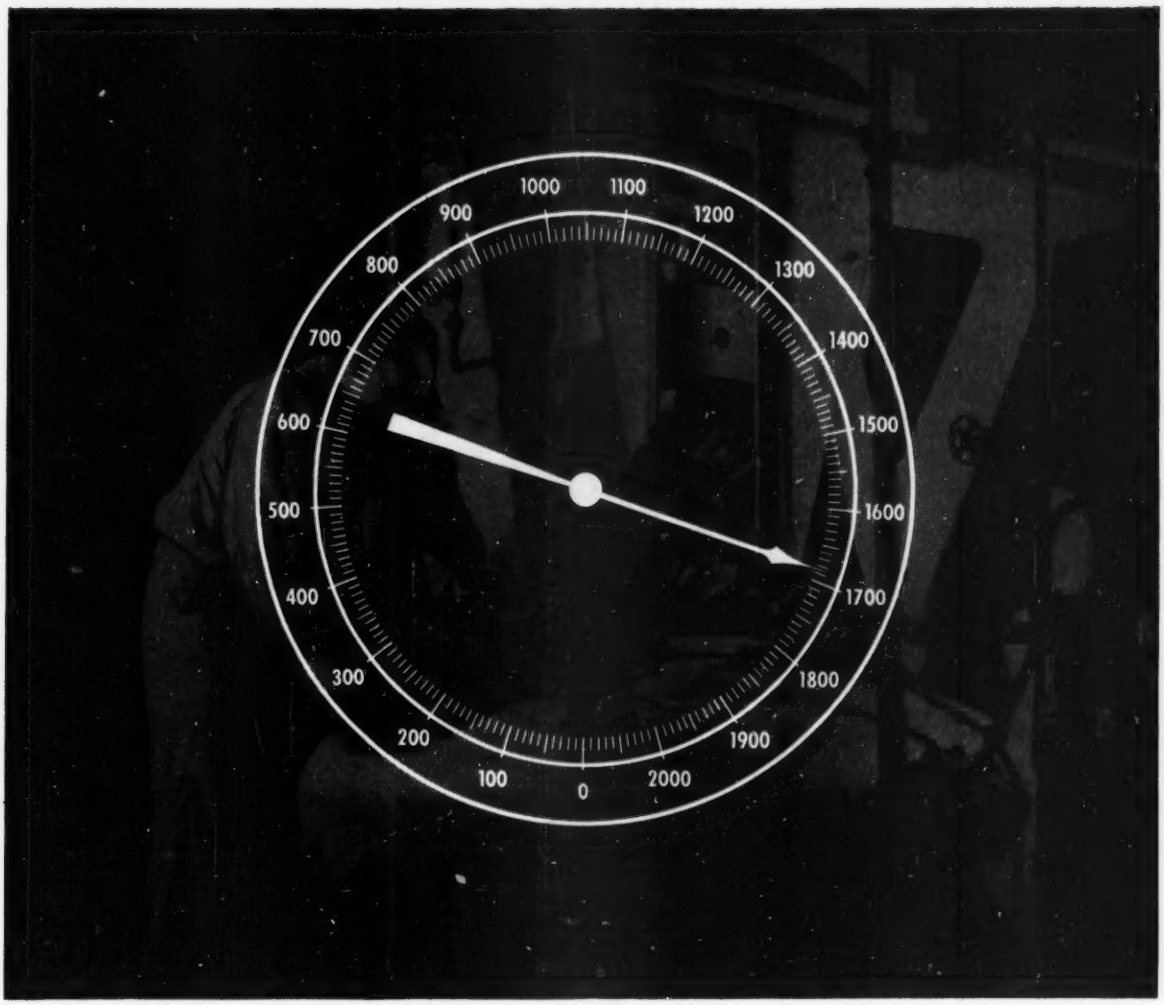

processing pressures versus operating safety

The trend in processing is moving towards higher temperatures and pressures. With it, the hazards of operating equipment are rapidly increasing.

Each of us—you as a processor, we as manufacturers of equipment—has a share in the responsibility for operating safety.

For fabricators of pressure vessels, the A.S.M.E. Code provides excellent rules and procedures which have, as a fundamental objective, safe operation. Here at Blaw-Knox, they are strictly adhered to, but as a *minimum standard.*

Into your Autoclave-Reactor, we design and build the maximum margin of safety permitted by the limitations of the job. The latest construction materials . . . new methods of stress analysis . . . recent developments in fabricating . . . the latest accepted principles of design—all contribute to operating safety. All are given careful consideration at Blaw-Knox.

Your Blaw-Knox Autoclave-Reactor is twice inspected at each stage of its completion. From initial design to final testing, it is carefully examined first by experienced Blaw-Knox Inspectors. Next, it is throughly re-examined by a fulltime Hartford Insurance Inspector hired to assure you of receiving a vessel which will be insured by any company.

These are important factors to consider when specifying an Autoclave-Reactor. They are the factors that make Blaw-Knox Autoclave-Reactors more reliable. When you buy, be sure to specify Blaw-Knox.

Write for Blaw-Knox Catalog No. 2413

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Blaw-Knox Equipment Division
Process Equipment Department
Pittsburgh 38, Pennsylvania

FOOTE BROS.—LOUIS ALLIS GEARMOTORS

Over 3500 different types and sizes to meet specific requirements exactly.

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Better Power Transmission Through Better Gears

Manufacturers of industrial gears and enclosed gear drives of all kinds, gearmotors, aircraft-quality gears, actuators and special machinery.

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Get all the facts and figures on how Foote Bros. drives with Duti-Rated Lifetime Gears can fit into your production picture. Write today . . . or see your local Foote Bros. representative now!

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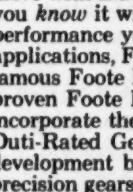
Now when you install an enclosed gear drive with Duti-Rated Lifetime Gears, you *know* it will give you the longer, trouble-free performance you're looking for! And for your applications, Foote Bros. offers you 2 different drives . . . famous Foote Bros.—Louis Allis Gearmotors and proven Foote Bros. Line-O-Power Drives. Both incorporate the world's finest industrial gearing, Duti-Rated Gears . . . a unique and revolutionary development by Foote Bros. that offers super-hard precision gears with much longer life and higher capacity than ordinary industrial gears . . . in much less space. For performance you can measure, quality you can trust—always insist on dependable Foote Bros. drives with longer-lasting Duti-Rated Lifetime Gears!



LINE-O-POWER DRIVES

Feature space saving, longer life Duti-Rated Lifetime Gears. Available in double and triple reductions with ratios from 5 to 1, up to 238 to 1; capacities range up to 200 h.p.

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Solve your complicated mixing problems

with a custom-made

GOLDMAN AGITATOR

JUST as if they were caught in a cataract, liquids are tossed around violently in a Goldman Agitator. And the mixing is rapid and thorough.

The Goldman Agitator is entirely new in principle. Baffles, which position themselves automatically, abruptly halt the whirlpool motion of the liquid on the surface, "folding" the liquid back on itself and then directing it downward through the cylindrical extension. Here, the stirring paddles pick up the liquid and create the rotary flow necessary to return the liquid to the baffles.

This unconventional cataract motion of the Goldman Agitator mixes liquid both vertically and horizontally; cuts mixing time and production costs. For example, when washing light oil with sulfuric acid and caustic, the Goldman Agitator cuts mixing time to a fraction of the time required in conventional mixers.

Product quality can be improved by using a Goldman Agitator; liquids are mixed with a *completeness* that cannot be approached by conventional mixers. We invite your inquiry concerning any of your problems in nitration . . . gas absorption . . . saturation . . . evaporation . . . distillation . . . concentration . . crystallizing . . dissolving, etc.

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Engineering and Construction Division
Chemical and Gas Department
Pittsburgh 19, Pennsylvania

KOPPERS

Another
CHEMICO
achievement

H_2SO_4 from an unusual raw material

By the completion of the 450 ton-acid plant for the Anaconda Copper Company at Weed Heights, Nevada, Chemico has added another unusual raw material to the list of materials from which Chemico plants produce sulfuric acid. Low grade ores containing 25 to 30 per cent uncombined sulfur are roasted in Dorr FluoSolids reactors to produce strong sulfur dioxide which is cooled, purified and processed into fresh acid of high strength. The plant has unusual features of design that permit it to operate at 150 tons or at 500 tons per day capacity with equal efficiency. • If your problem relates to sulfuric acid manufacture, concentration or recovery, Chemico can help you.

Chemico plants also make H_2SO_4 from these sources

- *Hydrogen Sulfide*
- *Sulfide Ores*
- *Sulfur*
- *Waste Smelter Gases*
- *Sulfur Dioxide*
- *Refinery Acid Sludge*
- *Spent Alkylation Acid*
- *Pickling Liquor*

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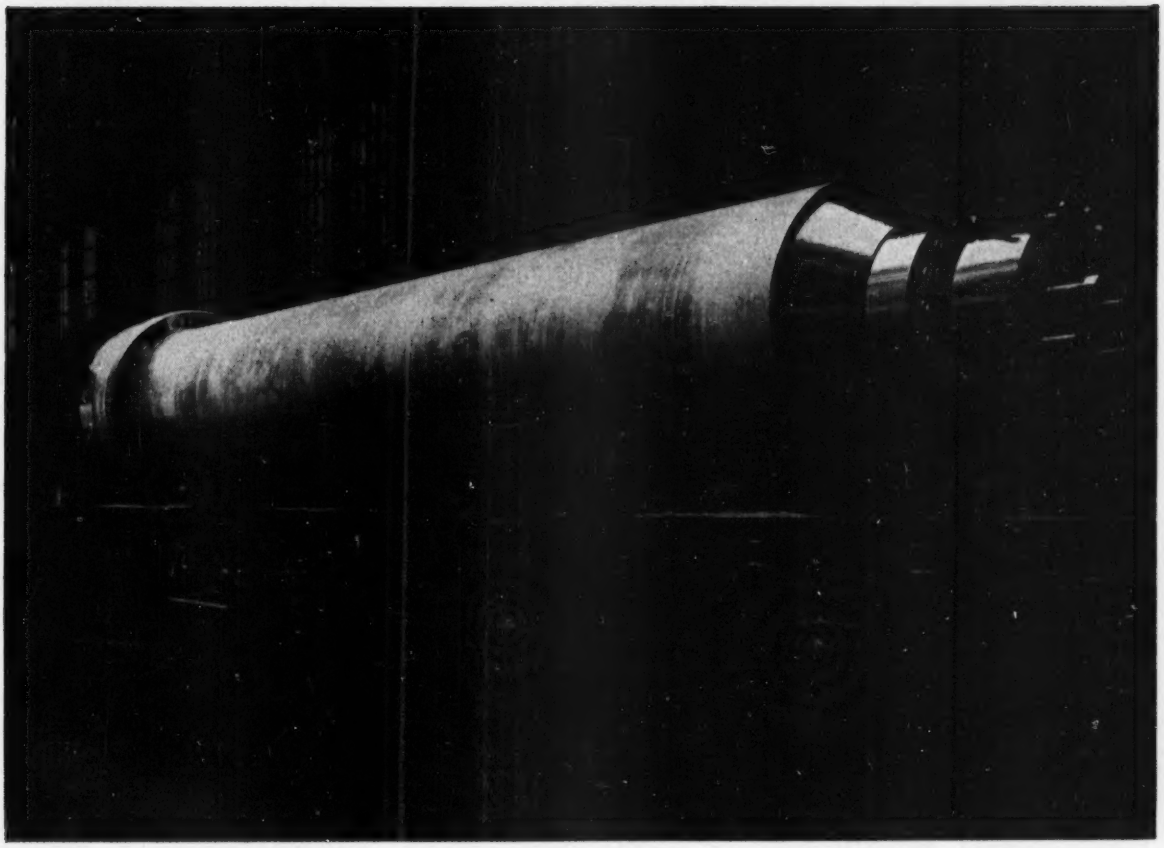
Chemico plants are profitable investments



Extra STRENGTH ... *Added* SAFETY ... *Sealed* for SERVICE

MIDVALE FORGED PRESSURE VESSELS

Product-Converter
Body Diameter-55"
Inside Diameter-40"
Ring Diameter-68¼"
Overall Length-37'—2-15/16"
Operating Pressure-5,625 P.S.I.
Tensile Strength-50,000 P.S.I.
Shipping Weight-144,240 lbs.

From the time this converter was on the drawing boards at Midvale until it was ready to roll on this flatcar strength and service was the keynote. Veteran steel makers melted the right alloy steel. Skilled hands forged toughness into it. Modern sonic, hydrostatic, strain gauge and X-Ray tests assured unfailing performance.

This converter is not unusual for Midvale—not the largest, not the smallest we make. A 268,000 pound octagonal ingot was forged and machined to an overall length of more than 37 feet with a body diameter of 55 inches. Hydrostatically tested at 8,450 psi. for working pressures of 5,625 psi. . . . yield strength of 50,000 pounds.

Midvale engineers, working with those of the chemical company, designed this converter to fit the specific needs of the plant. At one end of the vessel with full diameter opening the head is held on by a screwed yoke. Sealing is effected by a triangular-shaped copper gasket, sealing force attained by set screws. The other end of the vessel is closed down to about one-half the main diameter, bolted on and a self-sealing steel gasket of the "delta" type used.

Converters, autoclaves, separators, high-pressure accumulators, reactors . . . Midvale can forge them for your plant to meet specific processing requirements of pressure and capacity. Let our engineers work with you from initial design to final installation.

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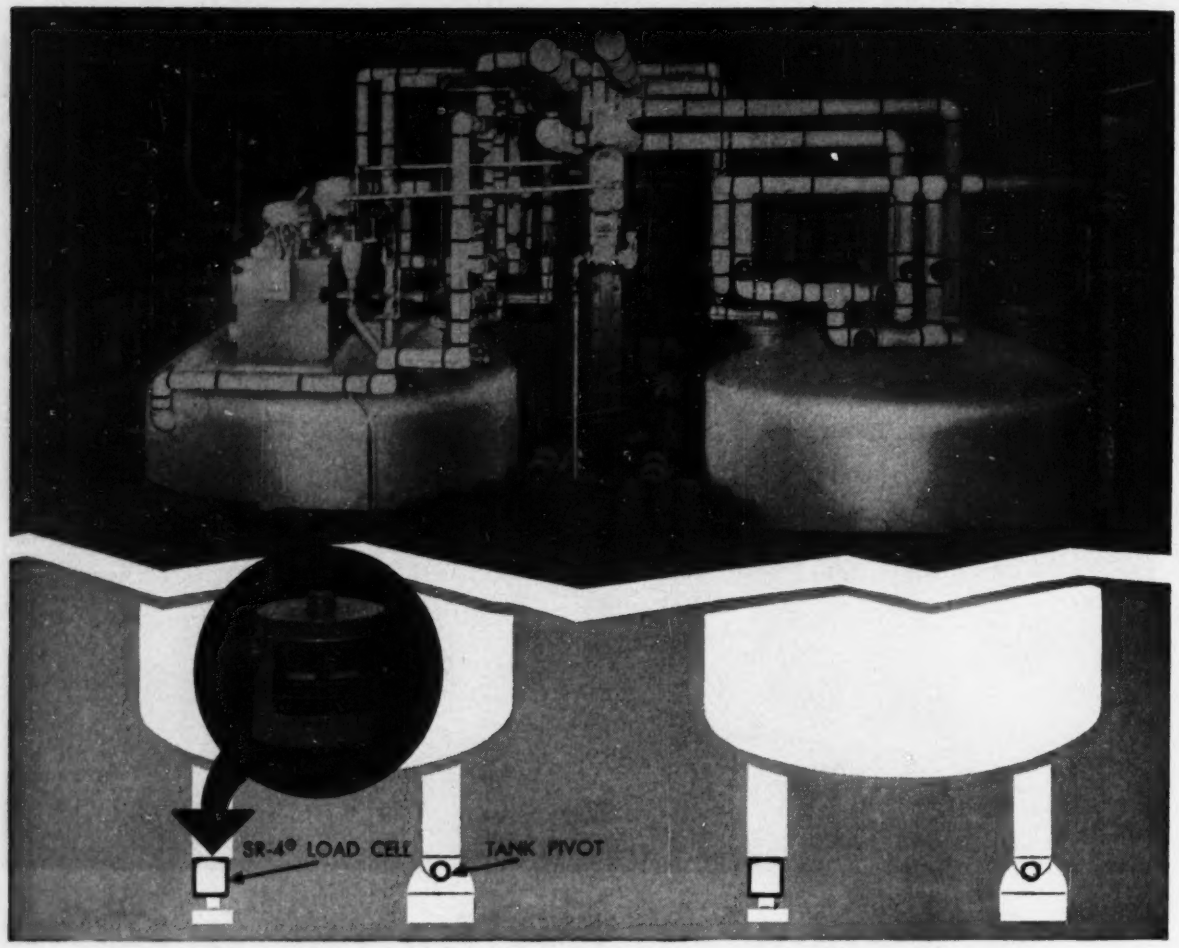
FORGINGS, ROLLS, RINGS, CORROSION AND HEAT RESISTING CASTINGS



Baldwin SR-4® Load Cells Permit Remote and Automatic Control of Latex "Batching"

THE PROBLEM:

In order to weigh liquid latex directly in the processing tanks, this leading rubber company sought a method which would require very little head room, use a minimum of steel and control various steps of each batch with ½ of 1% accuracy.

THE BALDWIN SOLUTION:

Every requirement was met by the installation of a Baldwin SR-4 weighing system. Each 2,000 gal. tank, holding 16,000 pounds of latex, is supported by three legs. Two of the legs have rod-end bearings and the third rests on one 10,000 pound SR-4 Type C Load Cell. As the tank fills, changes in its weight are transmitted by electric cables from the cells to a switching unit and an indicator-controller on the upper floor.

This system offers these benefits:

• It controls automatically the entire batching operation, providing lights and alarms for empty and full conditions of the tank. It also has adjustable controls between empty and full for sizing each particular batch by controlling motorized valves.

• The SR-4 system made it unnecessary to use much steel during installation. The small size of the load cells meant that the available headroom (14 inches) was ample.

• The SR-4 Cells' rugged construction and absence of moving parts, combined with good instrumentation and proper engineering, have enabled this system to maintain constantly its inherent accuracy of ¼ of 1% of capacity.

• Due to the electrical nature of SR-4 cells, they could be located on one floor and the indicating-controlling instrument on another.

SR-4 Devices in Industry... Uses Unlimited

For measuring load, fluid pressure, or torque more accurately and economically Baldwin SR-4 devices have *unlimited uses* in industry. Write for our two new booklets on tank weighing (No. 4106) and crane scales (No. 4105). Address: Dept. 3104 Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Penna.

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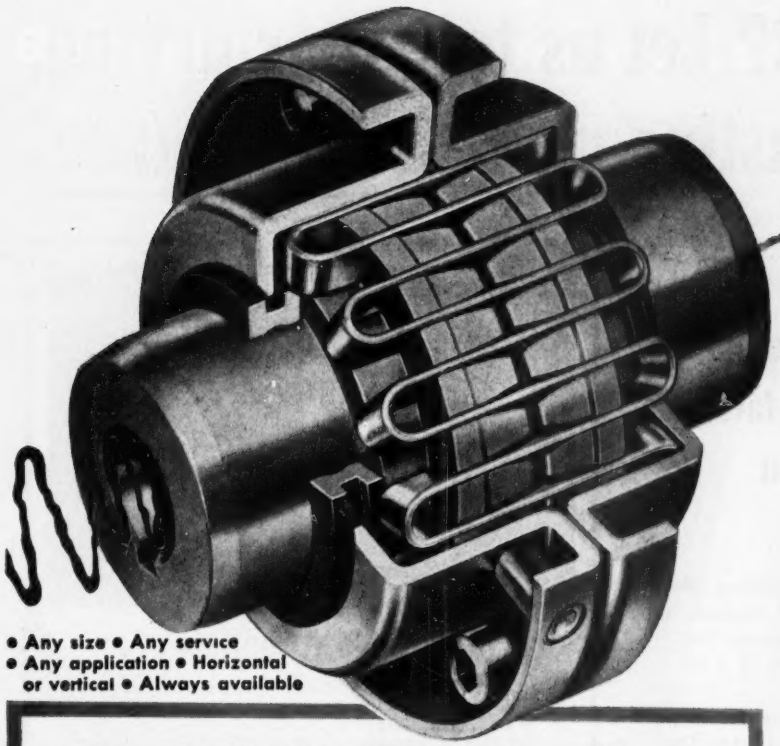
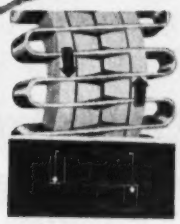


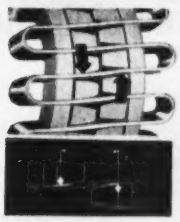
• Any size • Any service
• Any application • Horizontal or vertical • Always available

Exclusive FALK Steelflex grid-groove design smothers shock and vibration.

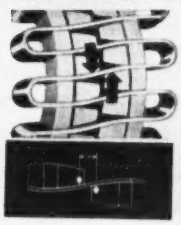
The damaging effects of shock and vibration can shorten the life of any connected machinery. Here is how the Steelflex grid-groove design overcomes these common enemies.



Under LIGHT LOADS
The gridmember bears only at outer edges of grooves. The long span between points of contact remains free to flex under load variations.



Under NORMAL LOADS
As load increases, the distance between supports on the grooves is shortened proportionately, but a free span remains to cushion shock loads.



Under SHOCK LOADS
Under extreme overloads, the grid-member bears fully on the grooves and transmits full load directly. The coupling remains flexible, within its rated capacity.

Why FALK Steelflex Couplings give the *finest* protection for connected machinery

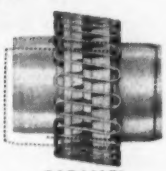
Maximum protection of connected machinery is best provided by Falk Steelflex Couplings because, thanks to their exclusive design, they overcome the damaging conditions of shock loads, shaft misalignment and vibration. How this unique multiple protection is made possible is shown at the right.

Falk Steelflex Couplings give the most economical protection, too, because they make connected machinery last longer and give better service. Furthermore, when actual coupling costs are figured per year of service, Falk Steelflex Couplings show substantial savings through their rugged all-steel construction, easy interchangeability and low maintenance requirements.

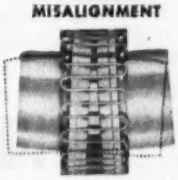
The basic Type F Steelflex Coupling—in 33 sizes to cover capacities from 2/5 through 70,000 hp per 100 rpm—meets over 90% of all industrial applications. Special or Dual Purpose Steelflex Couplings are available for problem applications. Write to Department 247 for engineering bulletin, including selection and dimension details.

...Accommodates shaft misalignment and free end float

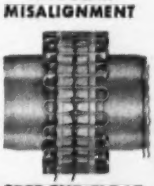
Basic maintenance procedure dictates regular inspection and correction of shaft alignment. Between inspections, Steelflex couplings provide protection by accommodating unavoidable shaft misalignment and end float. The gridmember which connects the two hubs of a Steelflex coupling is not fastened to either hub, so each hub can shift without imposing load on the other shaft.



PARALLEL MISALIGNMENT



ANGULAR MISALIGNMENT



FREE END FLOAT

THE FALK CORPORATION, Milwaukee 8, Wisconsin

MANUFACTURERS OF

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- Flexible Couplings
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- High Speed Drives
- Special Gear Drives
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FALK

...a good name in industry

WHY GAMBLE? Let us test your drying, cooling or roasting process in advance!

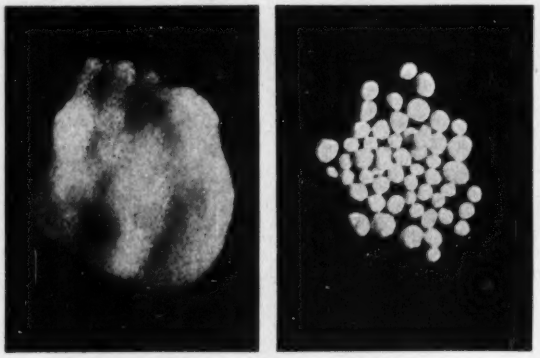
You are invited to utilize LINK-BELT's complete research and testing facilities . . . with no obligation

WHILE you're still in the planning stage, here's an exact method of determining the best process for your requirements. Send a sample of your material—a pound or a ton—to Link-Belt.

Our laboratories will work out procedures that can be duplicated in your own plant. Then our engineers can lay out flow charts, figure probable efficiencies . . . prior to actual construction. Or, if it's inconvenient to ship material, we'll furnish equipment to you for pilot work right in your plant.

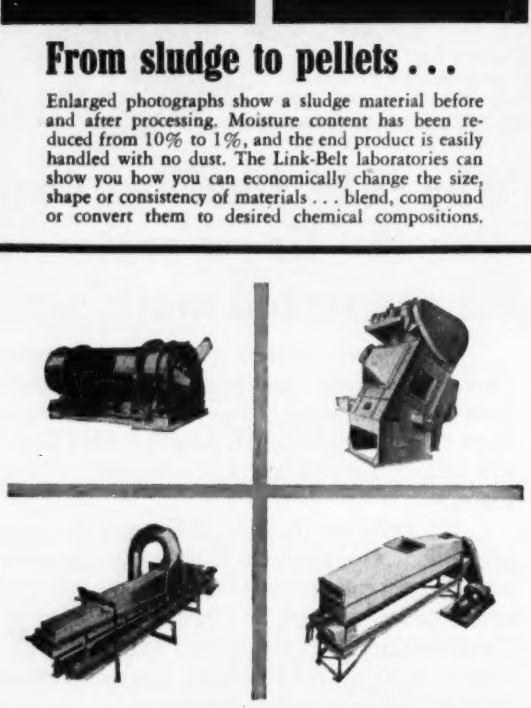
It's this complete development service that is in large part responsible for the more than 600 Link-Belt dryers now in service. They're operating profitably all over the world . . . successfully processing over 100 different materials.

Ask your Link-Belt representative about this no-obligation service today. He can also give you information and literature on Link-Belt's broad, quality line of processing and materials handling equipment.



From sludge to pellets . . .

Enlarged photographs show a sludge material before and after processing. Moisture content has been reduced from 10% to 1%, and the end product is easily handled with no dust. The Link-Belt laboratories can show you how you can economically change the size, shape or consistency of materials . . . blend, compound or convert them to desired chemical compositions.



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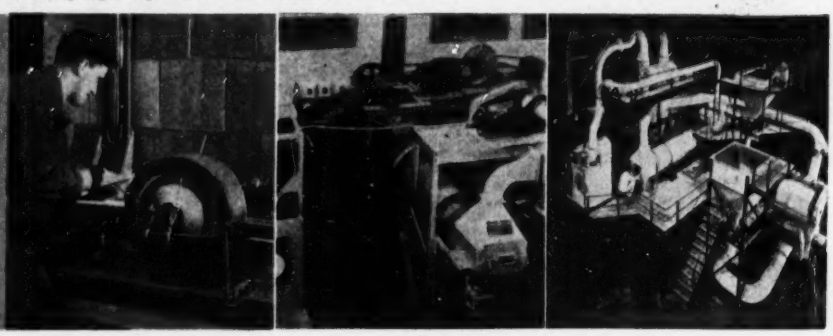
LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13,459

Miniature, reduced-scale and full-scale equipment at Link-Belt laboratories can test-run a pound or a ton of your material



We can CUT your Bulk Material Handling Cost

Let us prove . . . BY A DEMONSTRATION . . . the many advantages of loading with the combination of Clutch-Type Transmission and Hydraulic Torque Converter . . . brought to you by the

TRACTOMOTIVE TL-10 TRACTOLOADER

SEE how the smooth-operating HYDRAULIC TORQUE CONVERTER DRIVE speeds loading — no butting or ramming, no engine stalling. No clutching either — operator crowds steadily into pile using only the foot throttle and bucket control levers. Wheel spin is practically eliminated, tire wear greatly reduced. Bucket action is snappy at all times because speed of engine and hydraulic pump remain constant.

SEE how the specially designed CLUTCH-TYPE TRANSMISSION eliminates most shifting. You simply push a lever to go forward, pull it back for reverse. Reverse is almost twice as fast as forward.

SEE how easy it is to maneuver the TL-10. Bucket over drive wheels utilizes weight of load for greater traction... eases weight on rear steering wheels. Turning radius is only 11 ft. at tip of bucket . . . works in areas that would normally accommodate only lower capacity machines. You can turn from a 9-ft. aisle into a 10-ft. bin!

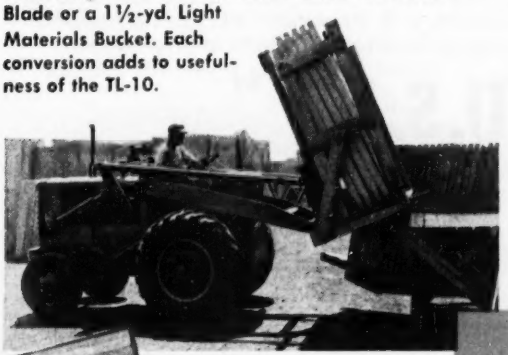
Only by watching the TL-10 work can you fully realize the great savings you can make on bulk material handling. Let us arrange a demonstration NOW! Wire, write or call.

Never-Anywhere— A WHEEL LOADER LIKE THIS!

¾ cu. yd. bucket — weight 11,400 lb. — 63 brake hp. Has dynamic, new Allis-Chalmers POWER-CRATER engine . . . gives you high-octane performance on regular gasoline.

POWER-CRATER is an Allis-Chalmers trademark.

Added Versatility Standard bucket is quickly interchangeable with Lift Fork, Crane Hook, Dozer Blade or a 1½-yd. Light Materials Bucket. Each conversion adds to usefulness of the TL-10.



Write to us — **for literature on the TL-10 and see your nearest Allis-Chalmers Industrial Tractor Dealer.**

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EVEN THE TOUGHEST ACIDS Shun this Joint

In acid-proof brick floors — in any type of corrosion-resistant masonry — the joint between the bricks is the critical point. Ordinary mortar joints won't do. Even many specialized "acid-proof" cements will handle only a limited range of acids. Others will handle acids but fail quickly under alkali attack.

But a joint made of Durisite will resist *both* acids and alkalis — will stand up under time, under abrasion, under impact.

Wherever corrosion is a problem you'll find materials and products by U. S. Stoneware on the job. Corrosion specialists since 1865, we work with many materials — with plastics, with rubber, with ceramics, with metals.

U. S. Stoneware's versatile Tygon plastics serve all industry: as clear, flexible hose for piping sensitive fluids, foods, pharmaceuticals, whole blood and blood plasma; as paint to protect concrete and metal surfaces from attack by corrosive fumes; as linings for tanks containing corrosive chemicals. In ceramics, "U.S." white chemical porcelain, and chemical stoneware, are fabricated into large and intricate shapes for chemical plant usage. In rubber—hundreds of specialized compounds meet highly exacting and critical needs. And in the new field of metallic oxides, U. S. Stoneware's ALITE offers solutions to corrosion problems once thought insurmountable.

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The U. S. Stoneware Co. has prepared two booklets which will prove helpful to any company concerned with any type of corrosion-resistant masonry. **"HOW TO BUILD AN ACID-PROOF BRICK FLOOR"** *and* **"CORROSION-RESISTANT MASONRY CONSTRUCTION GUIDE"** *are down-to-earth books with a wealth of pertinent, practical information. They are free, by request on your company letterhead. Write: The U. S. Stoneware Co., Dept. CE-854, Akron 9, Ohio.*

375-B

AUGUST 1954

Chementator

Edward T. Thompson

• Perchloric acid users may soon have a third source of supply, first in the West. Western Electrochemical Co., world's biggest perchlorate maker, plans to enter the field with a big unit at Henderson, Nev., is now developing new uses to expand the limited market.

• Direct fluid bed chlorination of zircon (zirconium silicate) is showing so much promise in the laboratory that the Carborundum Co. intends building a pilot plant for the new process.

New zirconia technique cuts energy costs

By a unique process that takes place in a rotary kiln at only 2,500 F., Zirconium Corp. of America will soon be making two zirconium oxides —pure or completely stabilized—at its new Solon, Ohio, plant. Residence time in the kiln is only 4 hours, compared with other processes that require 40 hours of fusing at arc temperatures well above 4,000 F. Thus ZCA has achieved important power savings.

At Solon, zircon sand and dolomite are intimately mixed in controlled proportions and charged to the kiln. Reaction is a base exchange, forming zirconia, plus calcium and magnesium silicates. When making the stabilized zirconia—said to be the only one on the market that's 100% stable—each crystal holds just the needed amount of lime in solid solution.

Soluble riboflavin production starts

By redistilling all C. P. solvents used and by using only glass and ceramic equipment in the actual processing, Hoffman-La Roche is now making soluble riboflavin commercially. Thus, formulators of both oral and parenteral solutions (for injection) will be able to attain higher concentration of ribo at lower over-all cost.

An earlier attempt to make a soluble product failed because metallic salts tended to settle out on standing. This necessitated elaborate purification precautions which have resulted in a metal salt concentration of only 1-2 ppm.

In essence, the process is this: USP riboflavin is reacted with chlorophosphoric acid made from redistilled phosphorus oxychloride. Reaction products are quenched in water, neutralized with caustic soda and filtered to yield riboflavin phosphoric acid ester. Reaction with diethanolamine produces the DEA salt, plus a number of by-products.

Successive fractional crystallization, using ethanol and two undisclosed solvents, yields a pure DEA salt. This is converted to the sodium salt with sodium acetate and ethanol, then dried.

Cost of the soluble form is $200 a kilo on a straight riboflavin basis, compared with only $100 a kilo for USP ribo. But the advantages of high, unaided solubility more than offset this difference.

Blaw-Knox offers fatty alcohol process

After a long successful run in Liege, Belgium, the Belgian SBA* process for continuous hydrogenation of fats to fatty alcohols is looking for a foothold in the U. S. Blaw-Knox is handling licensing arrangements, stipulates guarantees on quality, yield, operation costs and catalyst life.

Over-all fatty acid yield from tallow is 92%. And Blaw-Knox has set up a pilot plant to predict yields and costs for other domestic raw materials.

As it will be built in this country, the process consists of four steps:

• Fat, either animal or vegetable, undergoes steam hydrolysis in a Blaw-Knox continuous fat

* Societe Belge de L'Azote et des Produits Chimiques du Marlay

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splitter to produce fatty acids, with a 98% yield of glycerine.

• The fatty acids are mixed with methanol and continuously esterified under pressure. It's also possible to produce glycerine and methyl esters directly by alcoholysis of the glycerides with methanol. However the glycerol yield is lower by this method than by fat splitting.

• Fatty acid methyl esters are hydrogenated in two fixed bed catalytic reactors in series. In the first, carboxyl groups are reduced to hydroxyl; in the second, double and triple bonds are saturated. Next, hydrogen is separated and recycled and the products are flashed to recover methanol for recycle.

• The crude hydrogenation product is then vacuum distilled for any desired fractions.

Polyesters for cooling towers?

Still in the idea stage, but already exciting considerable interest, is the possibility of using glass reinforced polyester resins to build water cooling towers. Initial estimates indicate important strength and corrosion advantages over wood. Because of this high strength, towers should be able to be designed with more open space to achieve higher cooling efficiency.

Monsanto was the first chemical company to openly announce that it was pushing the development. And according to the company, several cooling tower manufacturers have also indicated active interest, including Fluor, Hydrocol, Pritchard, Marley and Hudson Engineering.

Most striking characteristic is the increased strength that permits a lower weight tower. Monsanto's design engineers calculate that a typical plastic tower would use 6 tons of polyester and 6 tons of steel. A comparable wood tower would weigh 25 tons when dry, probably 35-40 tons wet. In addition, polyesters resist fungus, bacteria and alkaline water. The last tends to delignify wood, particularly along the Gulf Coast.

Another attempt at chamber sulfuric

Despite considerable scepticism in industry, the much-publicized Kackraroff-Guareschi chamber sulfuric acid process is set for a commercial test in the U. S. A midwestern firm, whose name cannot be disclosed at present, is now acquiring the necessary land and fully intends to build a large-scale plant.

A number of successful plants utilizing the process are running in Europe, ranging up to 150 tons of acid per day (100% basis). Yet some of the KG claims are so startling that many American industrialists insist they must be shown. Among the claims are an estimated 50% saving in investment over a comparable contact plant and nearly 20% lower production costs, based on European operating results. In addition, conversion efficiency is estimated at 99.5%.

These savings are said to be achieved by allowing little or no gaseous nitrogen oxides to be liberated in the reaction, giving a reaction space as low as 0.4 cu. ft. per lb. of sulfur per day. This compares with 7-9 cu. ft. for standard chamber plants and 1.5-2 cu. ft. for the most sucessful of the so-called accelerated chamber processes.

Thickener ups alumina concentrations

Just arrived in this country is a French decanting system that industrial tests show can increase the concentration of bauxite mud by at least 25% over standard equipment without lowering throughput. Called the Gelsol process, it is also said to raise throughput rates by 75% when running to the same concentrations as standard equipment.

Its secret lies in the use of multiple groups of lattice or mesh stirrers that move extremely slowly through the compression zone of the mud slurry. These are said to break the waterbridges and chains that normally hinder thickening. According to Chemical Projects Associates of New York, the U. S. marketer, Gelsol blades can be installed in almost any conventional thickener.

Novel titanium aim—stable powder

Shying away as much as possible from titanium sponge, United International Research, New York, is now pilot planting two new electrolytic processes for direct production of completely stable titanium powder. Both promise a cheaper product.

Reason for aiming at stable powder is that it can be formed into parts by powdered metallurgy techniques with essentially no waste. Present fabricating methods for sponge require 4-5 lb. of metal to make a one-lb. finished part. Conventional titanium powders made by the hydride route are highly flammable and can't be made into parts.

On the cost side, UIR's president, Alfred R. Globus, expects to sell powder from process I at $10 per lb. Considering the waste involved with sponge, this is roughly a 50% saving. And if

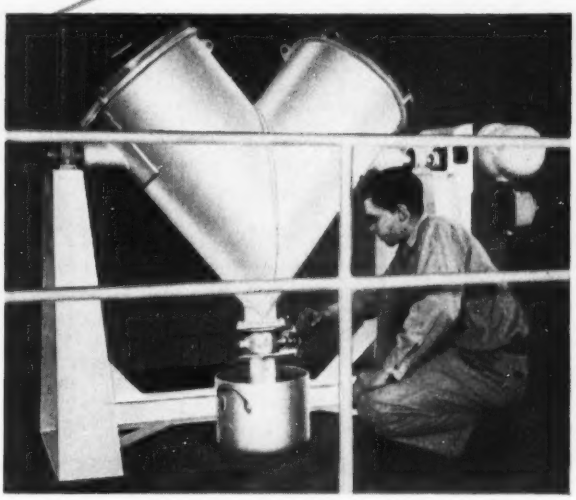
(Continued on page 108)

For good taste

For good health

For good blending

Vitamins
B_1, B_2, Niacin and Iron



Delicious Cream of Rice is a family favorite. Enriched with essential vitamins, it not only tastes good, but is good for you.

Thorough blending of vitamins is, of course, imperative. A **p-k** 5 cu. ft. stainless steel blender*, equipped with intensifier bar*, effectively blends four basic vitamins—niacin, thiamine, riboflavin and iron compound. This is another example where the food industry has selected the **p-k** twin shell blender to precision blend these important vitamins.

Loading is simplified by quick opening, dust-tight covers. Discharge is rapid, too, with the pre-blended vitamins emptied directly into containers for subsequent blending with the rice. Its smooth baffle-free interior facilitates clinical cleaning.

The application of **p-k** twin shell dry blenders to your particular processes will assure efficient blending at low cost. Why not pre-test your materials in **p-k**'s special blending laboratory. Send a sample of your materials for a thorough blending analysis, or write for catalog 12, no obligation.

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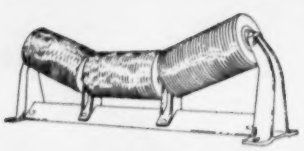
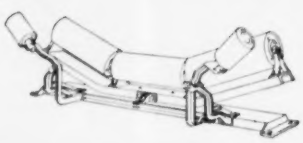
Years of customer research, laboratory development and field testing have produced this great advancement in the art of belt conveying. Built strong and well balanced for long, trouble-free service. Write for details.

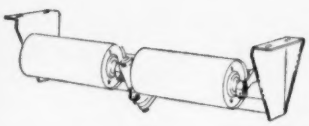
a type and size for every need . . .



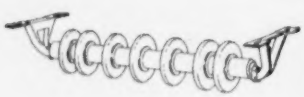
IMPACT ABSORPTION IDLER



TROUGHING TRAINING IDLER



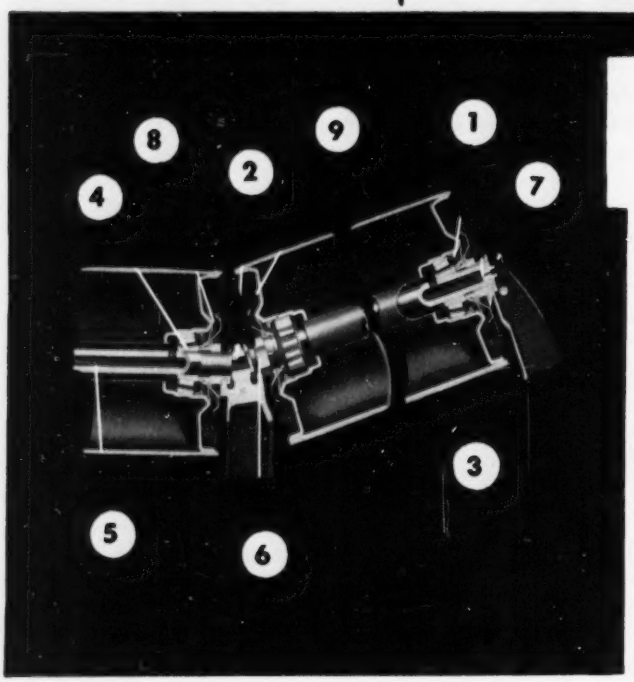
RETURN TRAINING IDLER



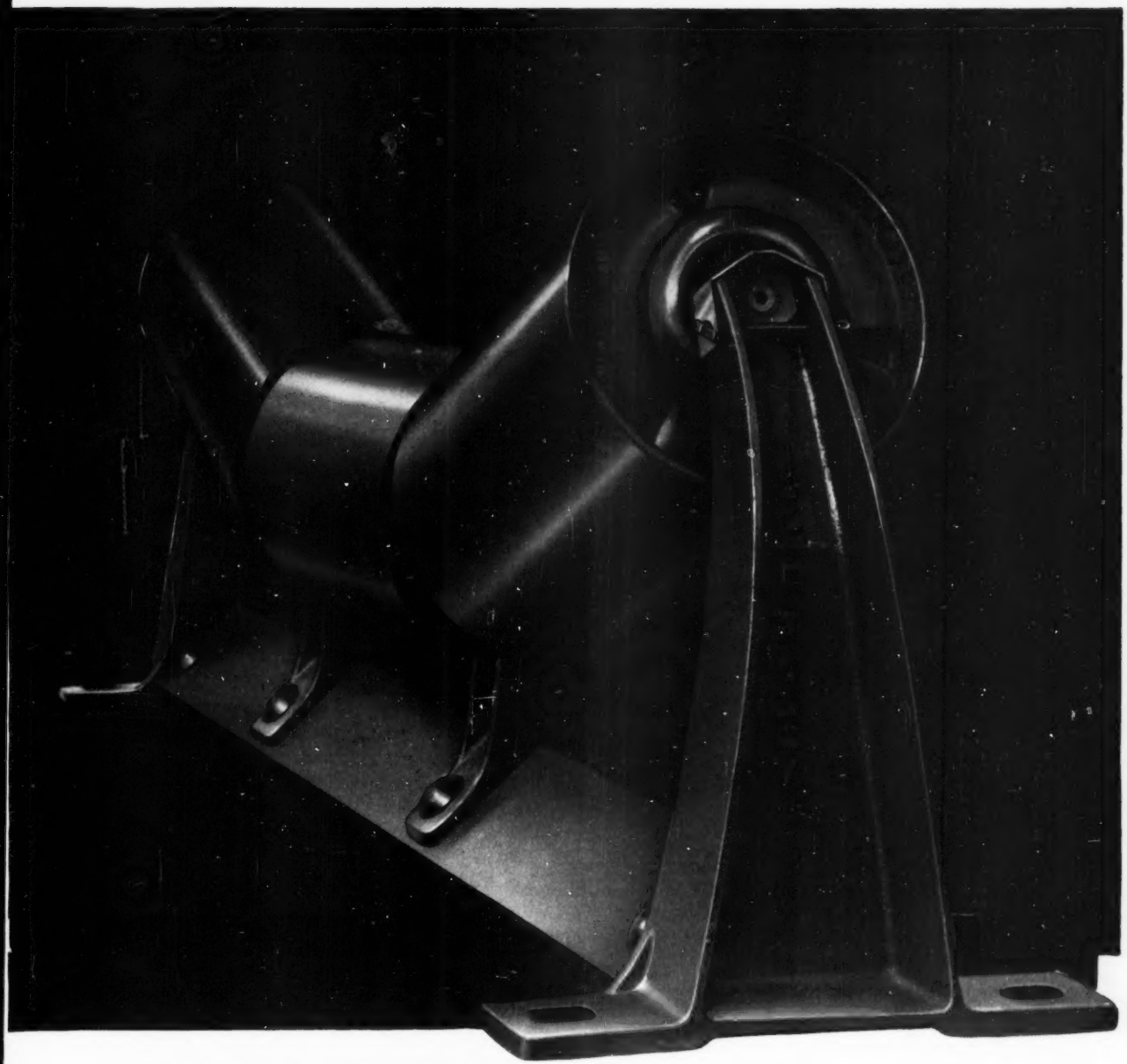
SPOOL RETURN IDLER

RETURN IDLER

SPOOL RETURN TRAINING IDLER



1. Factory lubricated, adjusted and permanently sealed with two flexible contact seals to keep dirt out and belt-damaging grease in, *for the life of the idler.* Fitted with vented plugs to prevent promiscuous relubrication.
2. Where desirable to relubricate or freshen the grease after long operating periods, "Neoprene" shaft connectors provide for relubrication from either end.
3. Heavy, welded steel pipe of uniform wall thickness. Roll ends machine smoothed to protect belt and workmen.
4. High-capacity tapered roller bearings snug-fit on shafts.
5. Stationary, tubular shafts with fine threads for minute bearing adjustment.
6. Entire assembly locked by grooved hex nuts which transfer load to stands.
7. Removable straps on center and end stands lock rolls in place during shipment and operation . . . facilitates removal of rolls.
8. Outer shields provide protection for seals.
9. Formed steel ends pressed and welded into place for maximum strength and true running rolls.



20° TROUGHING IDLER . . . locked-in roll assemblies form truss type construction . . . balanced design gives perfect distribution of weight and stresses . . . 2° tilted end stands for engineered belt training . . . minimum space between rolls prevents damage to belts . . . die straightened, high-strength, streamlined stands set up maximum strength-to-weight ratio . . . self-cleaning, inverted angle base . . . mounting feet cast integral with end stands to develop full strength of the idler . . . all types designed to provide the best in belt conveying operations.

THE JEFFREY MANUFACTURING CO.

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IF IT'S MINED, PROCESSED OR MOVED

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process II works out, he forecasts a price of $1.50-1.75 a lb.

But full scale operations are still much in the future. UIR is making 4 lb. of powder per day by process I, expects to complete a 30 lb. per day plant by fall. Process II is still bench scale.

Both processes start by electrolyzing titanium dioxide. Cell design, which differs between the two, is by Electric Heating Equipment Co. of Philadelphia, which also has a financial interest. Process I electrolyte melts at 700-800 F.; process II uses a lower melting electrolyte and higher current density, but achieves much higher current efficiency.

From here on the processes are identical. Sponge can be made under vacuum at 750-1,000 C., or, preferably, the powder can be produced by continuous leaching that minimizes hydrogen contamination. Complete powder stability is thought to be attained by formation of a layer—½% by weight—of oxide or nitride on the particles.

Such an impurity in a sponge titanium would result in ingots so nonductile as to make cold fabrication impossible. But since the powder is pressed and sintered, low ductility (Brinnell hardness over 300) is not important. Another advantage of pressed and sintered parts is high porosity—30-40%. This gives high strength at a weight comparable with aluminum. Alloys can be formed by this method, too.

Of course if you need thin sheet titanium, the powder can't be used. Therefore Globus envisions a 10 ton per day plant to make both sponge and powder by his process. However, UIR does not expect to build such a plant itself. Rather it plans to sell the processes to one of the big titanium makers.

Du Pont to get Dominican furfural

By the middle of next year Du Pont will be importing sizeable quantities of furfural from the Dominican Republic. It will come from a new $7 million, 15,000 ton a year plant now being erected there by Central Romana By-Products Co., a subsidiary of the South Porto Rico Sugar Co.

Vern E. Alden Co., Chicago, engineered the unit, which will process 1,000 tons a day of mill-run bagasse (sugar cane stalks). Other than the different raw material, the process used is essentially the same as that developed by Quaker Oats some years ago. In return for its know-how, Quaker will receive royalties for 10 years and an option to buy a minority stock interest at the end of that period.

So everybody benefits. Quaker and Romana will profit directly from the plant and Du Pont will get needed furfural to make adiponitrile for its nylon plants. On a broader scale, the project is another indication of American industry's faith in the growth potential of Latin America.

Petrochemicals no bed of roses

"The year 1954 has been and will be characterized by abnormally low return on investment for many petrochemical projects," says Robert E. Hulse, vice-president of National Distillers. "It is a year in which supply has caught up with demand on most petrochemicals."

Speaking before the Chemical Market Research Association, Hulse further deflated the petrochemical ballon when he said: "We look to see a marked decrease in the dollar volume of petrochemical projects announced during 1954, despite the fact that construction forecasts do not show any major dip."

More specifically, Hulse took up the present and future position of polyethylene. Several new plants are going up, including National Distiller's 50 million pound a year unit at Tuscola, Ill. But certainly there will be less justification for additional plants over the next several years.

And despite earlier predictions, no polyethylene production is expected by any of the new producers before April 1955. Total increased output next year won't exceed 75 million pounds and it's likely not to be over 50 million. Thus the situation in 1955 won't be overly competitive. However, by 1956, when all the new producers will be operating full blast, the picture will be quite different.

The polyethylene price outlook is delightful for the consumers. Overpriced now due to high demand, the level should drop from 41c. a pound to 38c. just before the new producers start up next year. It should keep falling in subsequent years until it reaches a plateau of 31c., plus or minus 10%, by 1958 or 1960.

Court opens way to natural gas curbs

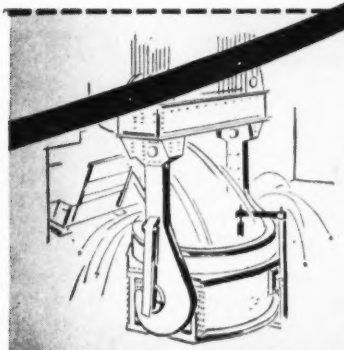
In a far-reaching decision that was followed by anguished cries across the country, the U. S. Supreme Court has ruled that natural gas sales by Phillips Petroleum—or any other producer or gatherer—to interstate pipeline companies are subject to rate controls by the Federal Power Commission. The ruling, by a 5-3 vote, affects 2,300 so-called independent companies.

(Continued on page 110)

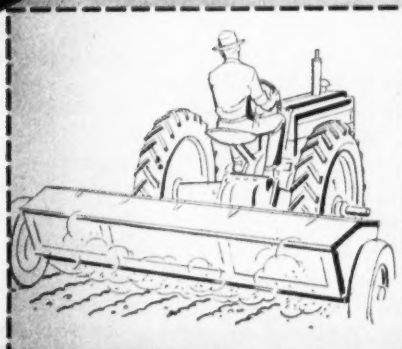
What has *aluminum* got to do *with...*

Salting an egg?

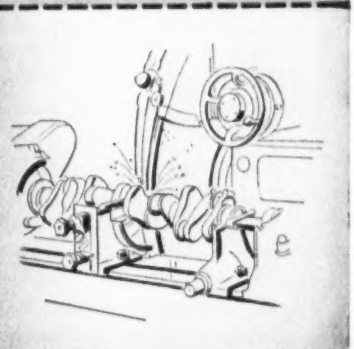
Purification of water?



Making steel?



Raising potatoes?



Grinding a crankshaft?

Alcan Chemicals are the answers

Alcan (Aluminum Company of Canada, Ltd.) offers industry the basic chemical ingredients used in ingot production and other chemicals associated with the aluminum processes. Many of these Alcan Chemicals are regularly used by industry to improve process applications and product quality.

In saltcellars, alumina, activated, absorbs moisture, makes salt easier to shake. For water purification, aluminum sulphate and chlorine are widely used in water treatment. Open hearth furnaces use magnesium oxide refractory bricks to increase steel output. Magnesia fertilizer is responsible for higher-yield potato crops. Alumina and bauxite are widely used for high quality abrasive wheels. These are only a few of the jobs done by Alcan Chemicals.

Co-operating in the production of Alcan Chemicals are a number of affiliated companies. Each of these sister companies specializes in its own field of endeavor such as: Laboratory research . . . exploring, mining and processing raw materials throughout the free world . . . development of shipping methods for the protection and speedy delivery of products.

One of Alcan's sister companies, Aluminium Limited Sales, Inc., distributes Alcan Chemicals in the United States. The office near you will be glad to help you with your special chemical requirements.

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- Alumina, Calcined
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- Aluminum Chloride, Anhydrous
- Aluminum Fluoride
- Aluminum Sulphate
- Bauxite
- Chlorine, Liquid
- Cryolite, Artificial
- Fluorspar
- Lime
- Magnesia
- Magnesium Chloride, Anhydrous
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Under the Natural Gas Act of 1938, as enforced until now, interstate gas line companies are regulated by a formula that provides a maximum return on investment of 5½-6%. Independent producers like Phillips, which neither owns, operates nor is affiliated with an interstate transmission system, have been exempt. Both Phillips and FPC argued that this was the law's intent.

But the Court ruled that when Congress passed the law it sought "to regulate wholesales of natural gas occurring at both ends of the interstate transmission systems."

Then the hollering started. Texas officials, both state and federal, claimed that the ruling was contrary to congressional aims. This was echoed by other states and by most oil company officials. Numerous plans were made to rewrite the laws. And Phillips asked for a rehearing of the case, a step the Court seldom takes.

The tenor of most objections was that the profit allowed under the public utility formula would force many gas producers to abandon interstate sales, that the risks involved in seeking and producing natural gas make it impossible for the industry to operate as a public utility. Dire predictions of resultant gas shortages in many parts of the country were also prevalent.

FPC execution of the Court's opinion will necessarily be slow. It will take a tremendous amount of staff work to get ready to hold hearings that must precede any actual rate settings. Moreover, most sources think that all litigation will have to be disposed of first, as well as any new legislation.

There's no doubt that new bills exempting the independents will be introduced into Congress. But they may well have tough sledding because proponents of regulation have the Supreme Court on their side. This isn't controlling (as was shown in the tidelands oil situation), but it helps.

Chemical refining gets new life

Initial operations are exceeding expectations at the new Alberta nickel refinery of Sherritt Gordon Mines, Ltd. Except that it uses ammonia to leach the ore rather than sulfuric acid, the $24 million installation is employing the same Chemical Construction chemical refining process attempted at the ill-starred Howe Sound cobalt refinery in Utah.

Sherritt Gordon and Chemico worked out the process jointly (see *Chem. Eng.*, June 1952, p. 164). It bypasses roasting, smelting, electrolytic and fire refining. And unlike the Howe Sound plant, which had and is having serious start-up troubles, this operation is smooth.

Ore concentrates containing high percentages of nickel and copper, plus some cobalt, are pressure leached with ammonia to remove unroasted sulfide ore concentrates; oxidation takes place almost simultaneously. Then direct reduction of the aqueous solution yields the desired metal powders.

The plant's production goals are understood to be 8,500 tons a year of nickel, 1,000 tons of copper, about 150 tons of cobalt and some 70,000 tons of ammonium sulfate.

Fat oxidation bids for users

In an attempt to cope with the much-vaunted domestic surplus of animal fats, Stanford Research Institute has developed a process to oxidize fats to dibasic acids. If it can be commercialized, and there are some definite handicaps, important new outlets for tallows and greases will be opened.

Both tallow fatty acids and saturated fatty acids have been used as raw materials. Oxidation is accomplished with 5-25% aqueous nitric acid at pressures below 200 psi. to produce a mixture of mono- and dibasic acids. Residence times have not been disclosed, but are said to be shorter than in conventional nitric acid oxidation processes.

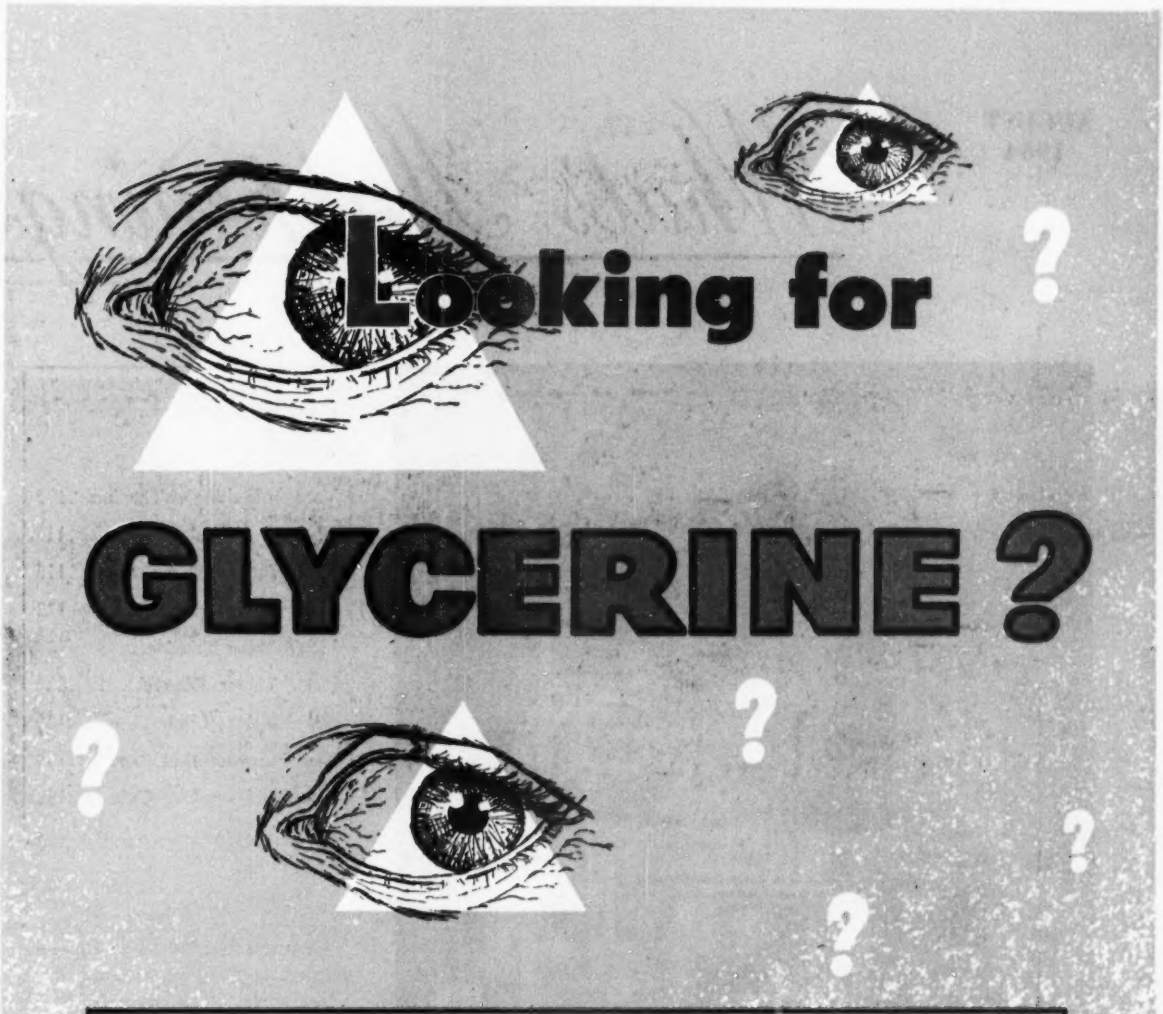
Following oxidation, the reaction mixture is steam-distilled to remove the monobasic acids. Unreacted fatty acids are separated and recycled to the reactor. At normal 50% conversion, reaction yield totals about 90%, 80% of which is dibasic acids, mostly in the C_6-C_{10} range.

Major advantages to the SRI process are that it can be applied to any fatty acid and preferentially produces dibasic acids at a fair weight yield of total products. In addition, control and separation are simple, no catalysts are needed and corrosion is negligible.

But SRI is quick to admit disadvantages, too. Probably the most serious are that mixtures are produced and about 20% of the nitric acid charged is consumed. At present, break even prices per lb. of total product are estimated at 17c., when operating a plant consuming over 10 million lb. of tallow acids annually. This is slightly higher than for dibasic acids made by ozonation of oleic acid.

That there's a need for a process to utilize animal fats is attested by the fact that last year's exports (potential surplus) totaled 1.2 billion lb., 43% of production. In 1951 exports amounted to only 0.5 billion lb.

What's Happening . . . 112



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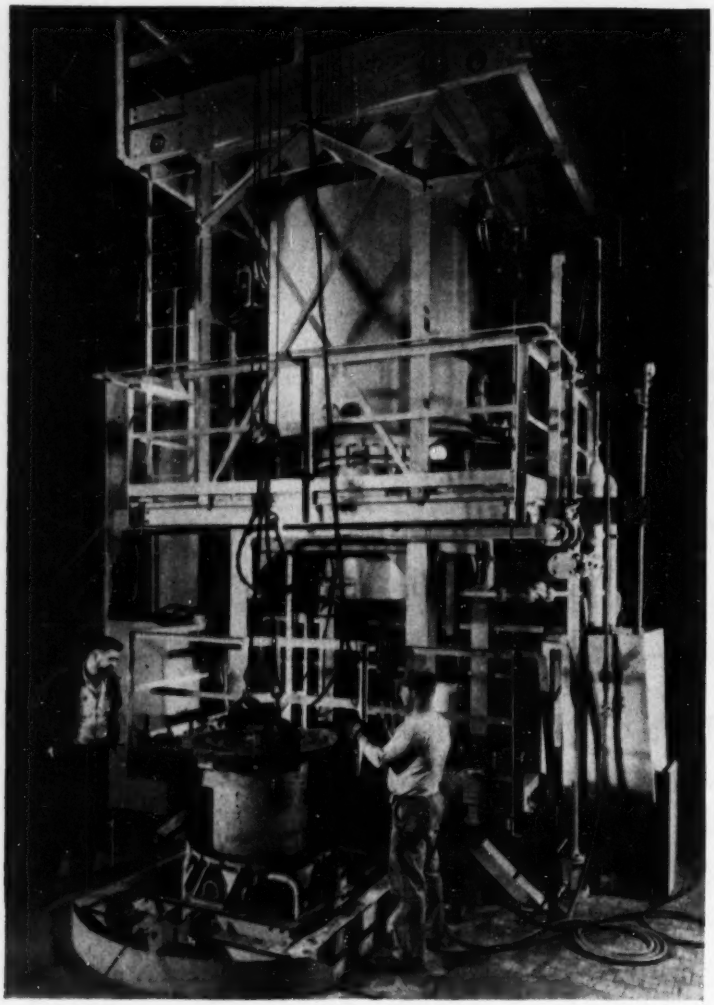
What's Happening



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Vacuum Gives Better Titanium

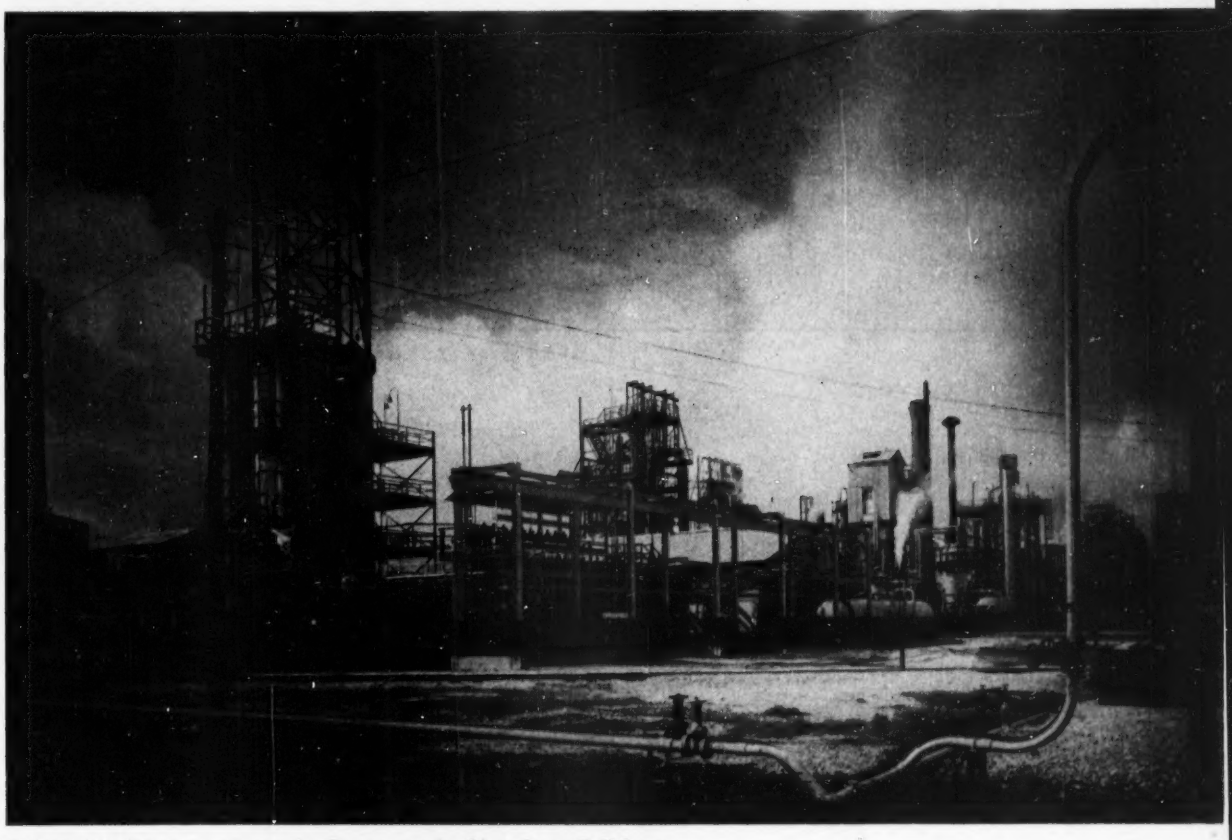
Perfection of a new vacuum melting process permits removal of hydrogen from titanium metal down to as low as 50 parts per million. This points the way to significant cost reduction, too, says Titanium Metals Corp. of America, developer of the technique.

Conventional remelting furnaces depend on flooding with argon or argon-helium mixtures under slight positive pressure. But studies of the detrimental effect of hydrogen on titanium's physical properties indicate the need for more efficient purification.

First installation of the process is at TMCA's Henderson, Nev., plant (*left*). This 20-ton double melting furnace of proprietary design completely remelts 4,000-lb. titanium ingots. Operating results have been so good that further improved units are now under construction and furnaces for 8,000-lb. ingots are receiving serious consideration.

Besides improved metal homogeneity, the vacuum procedure has shown more stable electrical arcs, the ability to accommodate higher power input and the production of smooth ingots that require little or no conditioning prior to continuous mill conversion into sheets, strips, bars or billets.

in Chemical Engineering



ISO-OCTYL alcohol is made via the Oxo process in this unit, as Gulf becomes . . .

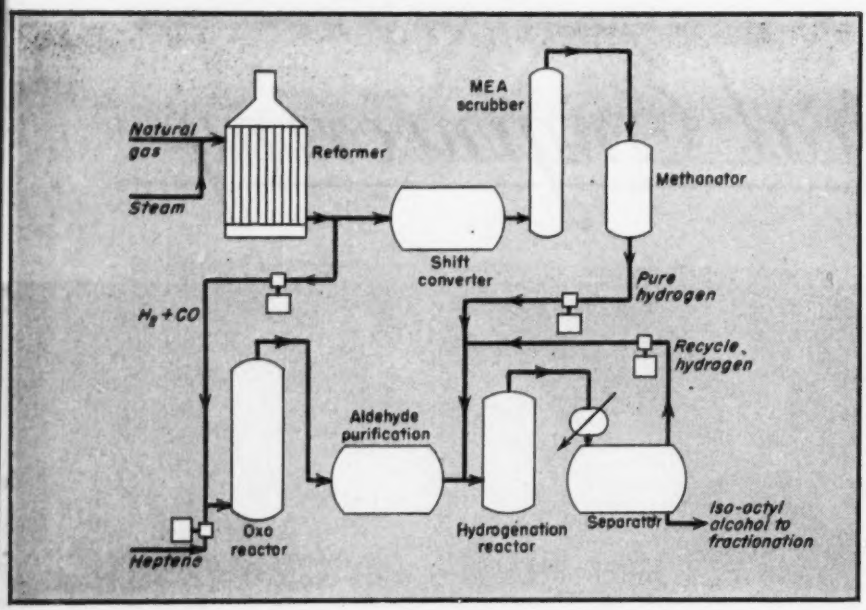
Latest Entry in Petrochemical Field

Although long a producer of chemicals for internal consumption or long-term contract, Gulf is selling its newest organic chemical product on the open market.

Gulf Oil Corp.'s iso-octyl alcohol unit at Port Arthur, Tex., has completed a year of operation, with a rated capacity of 9 million lb. per yr. Process used is a modification of the Oxo process developed in Germany during World War II.

Beset with more than its share of troubles—including two fatalities from nickel carbonyl poisoning—Gulf seems to have its problems pretty well licked. Tankcars of product are rolling out of Port Arthur now, and quality is better than was originally anticipated.

Plans for the unit were first announced early in 1951, with operation expected by the end of that



year. Construction wasn't finished, however, until late 1952, because strikes delayed the job. The unfortunate accident occurred during trial operations in April of last year.

► **Petrochemical Entree** – Commercial availability of iso-octyl alcohol marks Gulf's initial venture into the general organic chemicals market. Previous chemical products of the company have been made either for internal consumption or for sale under long-term contracts.

Good example of the latter is ethylene. Output of Gulf's existing unit–2½ billion cu. ft. per yr.–is sent via pipeline to Koppers, Ethyl, Du Pont, Monsanto and Allied plants in the Port Arthur vicinity. A second ethylene unit–3 billion cu. ft. per yr.–is now under construction. Much of the new capacity is already contracted for; Spencer Chemical is one of the customers, for its a-building polyethylene plant.

► **Now There Are Three**–Gulf joins two other petroleum refiners–Esso Standard and Standard of Indiana–in the iso-octyl alcohol business. Esso was in first, with a unit at Baton Rouge in 1949; expected cost and capacity were unofficially reported at that time to be $2.5 million and 30 million lb. per yr. Standard's plant at Wood River, Ill., is still in initial stages of operations. Its capacity is 10 million lb. per yr.

Iso-octyl alcohol goes into manufacture of plasticizers, synthetic lubricants, surface-active agents and agricultural chemicals. Plasticizers can be made by reacting the alcohol with phthalic or maleic anhydride. Iso-octyl alcohol can be sulfonated to make detergents, oxidized to fatty acids.

Gulf's facilities are quite flexible as to specific product. In addition to iso-octyl, Gulf can make nonyl, decyl, tridecyl and other alcohols.

► **German Oxo Process**–All three producers use processes patterned after the Oxo process originally developed in Germany. This process involves the addition of carbon monoxide and hydrogen to an olefin to get an aldehyde with one carbon atom more than the starting olefin; the aldehyde is subsequently reduced to the alcohol.

Gulf starts with a purified close-boiling heptene heartcut fractionated out of whole propylene-butylene polymer at its Cincinnati refinery and shipped by barge to Port Arthur.

In the Oxo reactor, the heptene is contacted with equimolal quantities of CO and hydrogen at approximately 3,500 psi. and 350 F., in the presence of a metallic catalyst, to produce octyl aldehydes. Isomerization of some of the heptenes to more active forms also takes place, so that over-all conversion is about 80 percent. Special reactor design permits close temperature control and achieves maximum conversion.

► **Reduction Step**–Hydrogen from the natural gas reformer is purified in two stages of shift conversion and scrubbing with monoethanolamine solution, plus a methanation step to remove the last traces of carbon monoxide.

Aldehyde is completely reduced to the corresponding alcohol in the presence of a supported nickel catalyst at 500-1,000 psi. and 350-400 F. Heat of reaction is removed by recirculating hydrogen.

The aldehyde must be hydrogenated completely, since some of the unwanted isomeric aldehydes can't be removed from the alcohol product by fractionation. For this reason, and to insure a long catalyst life, the Oxo product and the fresh hydrogen feed pass through purification steps where trace metals, CO, sulfur and other impurities which might contaminate the catalyst are removed.

► **Gulf's Accident**–Unforeseen formation of nickel carbonyl caused the death of two workers during a reactor repair in April 1953. The toxic gas was formed when natural gas combustion products were used to purge the vessel before opening (thought to be acceptable practice for H_2-filled systems). A small amount of carbon monoxide in the purge gas reacted with nickel catalyst to form nickel carbonyl.

Although several workers got sick when the reactor was opened, aldehyde and alcohol fumes were first blamed. True nature of the accident came out only after further investigation.

Now, nitrogen alone is used for pressure testing, heating the catalyst and purging. Every precaution is taken to prevent any recurrence of the conditions which caused the accident.

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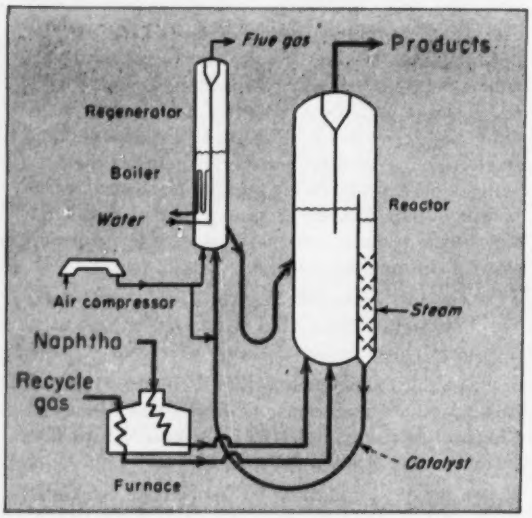
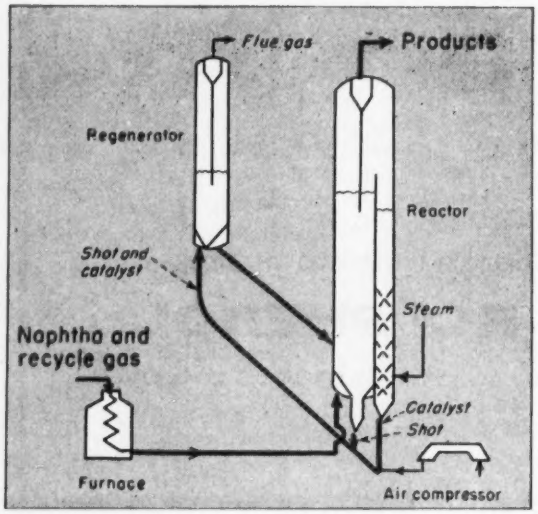
Phenol starts its trip to a customer from a siding at RCI's Tuscaloosa plant where it is being loaded into a tank car.

Formaldehyde
Glycerine
Maleic Anhydride
Phthalic Anhydride
Phenol
Sodium Sulfate
Sodium Sulfite



MODEL I Fluid Hydroformer needs high gas recycle for heat.



MODEL II recovers all regenerator heat, uses thin reactor.

New Hydroformer Is 15-20 Percent Cheaper

Circulating inert solids with catalyst adds a new heat source to Fluid Hydroformers. This lowers gas recycle rates, permits much smaller reactor diameters.

Although you can't trade in your old Fluid Hydroformer on Standard Oil Development's new Model II, if you were thinking of building a new one you're in for some big savings. Investment cost is down 15-20% and processing costs have been cut 7-10c. per barrel of feed, all without yield or octane sacrifice.

To achieve this, SOD simply made the most of the biggest inherent heat source in the process—the catalyst regenerator. A stream of relatively coarse, dense, inert solids, called shot, circulates with the catalyst, conveying to the reactor all the heat of regeneration that can't be transported economically by the catalyst alone.

▶ **Old Model Limited**—Usable regenerator heat in present-day Hydroformers constitutes about 20% of that needed for reaction and is controlled by catalyst circulation rates. But high rates, which would raise heat recovery, promote carbon laydown and greatly increase the amount of compressed air needed for regeneration.

The only other internal source of heat is the sensible heat of the naphtha feed. This amounts to 25% of the reaction heat but is fixed because the feed can't be heated above 1,000 F. without serious degradation from thermal cracking.

The remaining 55% of the required heat of reaction is supplied by heating reactor tail gas to 1,200 F. and recycling it to the reactor. Again, this temperature is limited by degradation that occurs at higher levels. Also it's expensive because the gas must be compressed, heated and cooled and, more important, big gas volumes mean large reactor cross sections.

▶ **Cut the Recycle**—The new shot-catalyst system, which was proven in a 50 barrel per day pilot plant at Baton Rouge, La., minimizes the amount of recycle gas because it recovers all regenerator heat. At the same time, gas pre-heat temperature is lowered to 1,000 F. so that gas and naphtha can be mixed before entering the furnace.

Thus investment savings in compression, furnaces, heat exchangers, cooling water and power are realized. Process and economic evaluations of a theoretical 22,000 barrel per stream day unit for 92 octane gasoline (research method without tetraethyl lead) from virgin naphtha are summarized below.

	Model I	Model II
Recycle gas, cu. ft./bbl. of feed	4,700	2,000
Catalyst-to-oil ratio	1.0	0.6
Shot-to-oil ratio	None	3.1
Cooling coil duty, Btu./lb. of feed	100	None
Air, std. cu.ft./bbl. of feed	541	685
Compressor, brake hp.		
Air	3,100	3,900
Recycle	2,400	800
Total	5,500	4,700
Furnace heat absorbed, 10⁶ Btu./hr.	125	75
Heat transfer surface, sq. ft.	50,000	32,000
Reactor steel, lb	620,000	380,000
Reactor utility consumption		
Power, kw	4,900	3,200
Cooling water, gpm	5,900	5,100
Steam, net lb./hr.	−1,500	5,100

▶ **Easy Control**—Shot, being considerably more dense than catalyst, settles rapidly through the fluid bed. Even at a shot-to-catalyst ratio of 3.0 at the reactor inlet, the average shot concentration just below

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HOUSTON 12, TEXAS

HOUSTON PHONE WENTWORTH 1651
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RICHARD B. KAHLE
PRESIDENT

March 16, 1954

Mr. George R. Brown
Executive Vice President
Brown & Root, Inc.
P. O. Box 3
Houston 1, Texas

Dear Mr. Brown:

The rehabilitation of our alkylation unit and its conversion from hydrofluoric to sulfuric catalyst type was completed by your people last month and put into immediate operation. The work was finished in a hundred and one working days from the date you were given the contract.

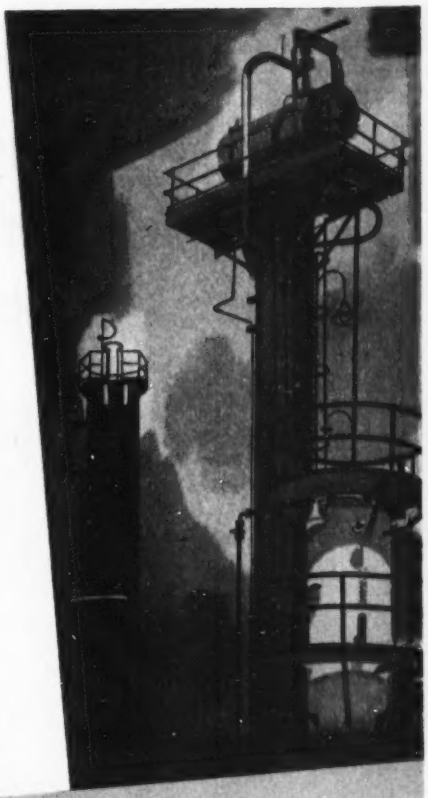
This work, I believe, sets a record in two cases: first, in time of completion; and, second, in the fact that the plant started up immediately on completion, was gradually brought up to capacity, is running at more than designed capacity, is running at full designed specifications and has required no substantial change of the equipment as completed.

As I told you shortly after this job began, it was of great importance for us to finish it promptly and have it in operation at full capacity immediately upon completion. You personally stated that you would do everything you could to expedite the completion and that it would be a good job. You have certainly complied in both instances.

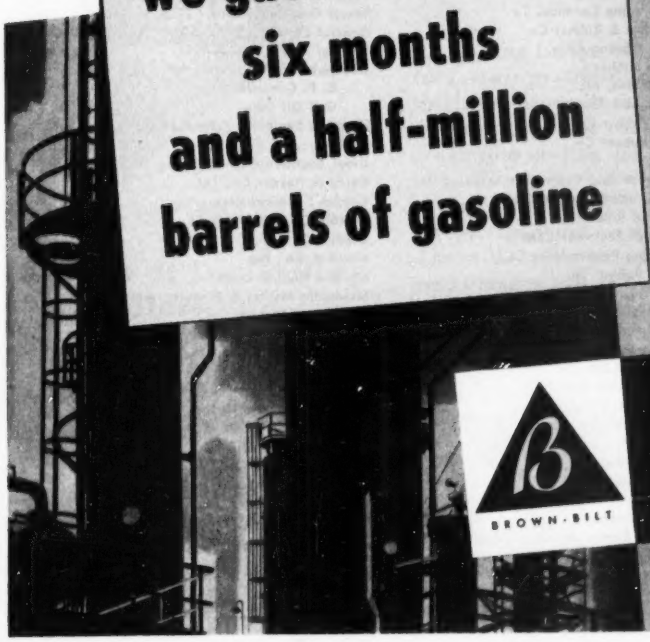
I want to thank you personally, and for my associates in the company, on the job you did for us and I wish you would convey to your associates who worked on this construction, our grateful appreciation and thanks.

Sincerely yours,

R. B. Kahle



we gave them back six months and a half-million barrels of gasoline



The new Eastern States Petroleum Company's aviation gasoline refining unit chalked up another rapid completion for Brown & Root. The plant was finished in the record time of 101 working days . . . cutting more than six months off normal construction time.

Early completion of a project means a bonus of unexpected production which, in the final analysis, represents a gratifying reduction in plant cost.

If your organization plans construction, contact Brown & Root. Planning experts will be put at your disposal . . . no obligation, of course.

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BROWN & ROOT, S. A., Panama City, Panama

the inlet is only 0.1 lb. per lb. of catalyst. Also, the rate of shot and catalyst withdrawal from the reactor can be controlled independently in either two separate streams or a single stream of the desired ratio.

Increased flexibility is another important feature of Model II, particularly the ability to handle variations in carbon production that result from changing feed stock. With a high carbon yield, catalyst rate is reduced below design value and shot circulation correspondingly increased so that heat to the reactor remains constant.

Finally, higher catalyst activity was attained in the pilot plant work as a result of the decreased gas recycle and space velocity had an over-all increase of 40%.

► **Commercial Possibilities**—As of now, no full-scale units have been designed for actual installation. Nor has it been decided whether in a commercial unit catalyst and shot will be removed separately from the reactor or in a single stream. But SOD definitely expects to use Model II design in all new Fluid Hydroformers and various companies in the Standard Oil (N. J.) group are actively studying preliminary designs.

Alumina Chemicals Plant Is Nearly Completed

Three of the four production units of Aluminum Co. of America's new chemical products plant at Bauxite, Ark., are in operation. When the rest of the plant is brought on stream sometime this summer Alcoa will be able to offer the widest variety of processed alumina chemicals in the world.

Each unit is designed to produce a different type of product. The four groups are Hydrated Aluminas (C-30 series), calcined aluminas, ground and blended special aluminas and tabular aluminas. The rest of Alcoa's alumina chemicals, plus its fluoride chemicals, will continue to be made at E. St. Louis, Ill.

Raw material for the first two operations is a slurry of alumina trihydrate ($Al_2O_3 \cdot 3H_2O$) made in the adjacent main bauxite works by the Bayer process combined with red mud sintering. To make the hydrated aluminas, only filtering and drying equiyment is needed. For calcined aluminas, the slurry is washed and filtered to remove impurities, then fed to rotary kilns as filter cakes. Control of time and temperature in the kiln provides differing crystal and particle growth during calcination. Blending alone, or grinding and blending together, takes place in the third unit.

Most important applications of the hydrates are in the production of iron-free alum, silica-alumina catalysts, sodium aluminate and heat resisting glass. Calcined aluminas, because of their resistance to high temperatures and superior hardness, are used as abrasives, in ceramics and as electrical insulators for spark plugs.

Rubber Plant Bids In, Commission Pondering

From now until Dec. 27, the government's rubber plant disposal commission will negotiate with the 35 companies, big and small, that submitted bids late in May for 27 government-owned synthetic rubber plants. By that time, the commission must complete recommendations for Congressional approval.

A total of 56 first-line and 19 alternate proposals were tendered the commission. Some were termed very good, others, poor. But all can be revised during the negotiations. It's expected that the final sale will bring in about $300 million. The plants originally cost $550 million, now have a book value of $180 million.

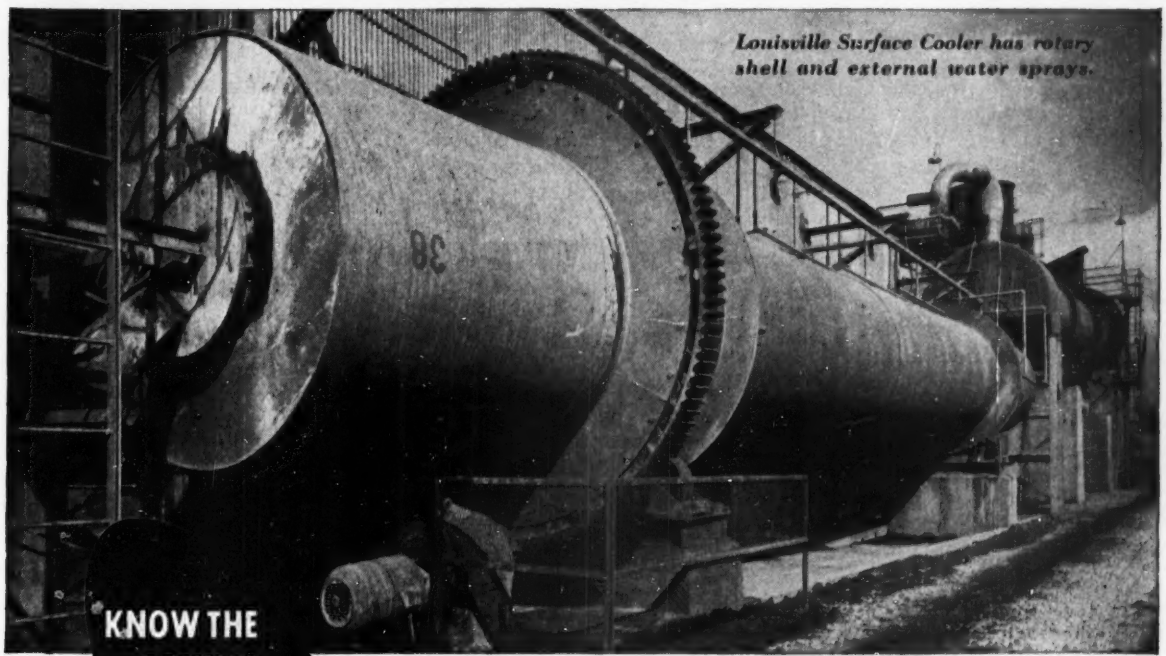
Listed below, in alphabetical order, are the names of the bidders that submitted one or more offers. In some cases, the names of the participating companies or shareholders are indented under the name of the bidder:

- American Chemical Corp.
  - Richfield Oil Corp.
  - Stauffer Chemical Co.
- American Synthetic Rubber Co.
  - American Biltrite Rubber Co.
  - American Cyanamid Co.
  - Anaconda Wire & Cable Co.
  - Brown Rubber Co., Inc.
  - Dewey & Almy Chemical Co.
  - Dunlop Tire & Rubber Co.
  - Endicott-Johnson Corp.
  - Faultless Rubber Co.
  - Hewitt-Robins, Inc.
  - General Cable Co.
  - Goodall Rubber Co.
  - Johnson Rubber Co.
  - Kys Corp.
    - Bata Shoe Co., Inc.
    - Bristol Manufacturing Co.
    - Converse Rubber Co.
    - Goodyear Footwear Corp.
    - La Crosse Rubber Mills Co.
    - Servus Rubber Co.
    - Tingley Reliance Rubber Co.
    - Tyer Rubber Co.
  - Phelps Dodge Copper Products Corp.
  - Raybestos-Manhattan, Inc.
  - Rome Cable Corp.
  - Seamless Rubber Co.
  - Simplex Wire & Cable Co.
  - Sponge Rubber Products Co.
  - Thermoid Co.
  - Wooster Rubber Co.
- Climax Molybdenum Co.
- Copolymer Corp.
  - Armstrong Rubber Co.
  - Armstrong Rubber Manufacturing Co.
  - Dayton Rubber Co.
  - Gates Rubber Co.
- Copolymer Corp., cont.
  - Mansfield Tire & Rubber Corp.
  - Sears, Roebuck & Co.
  - Seiberling Rubber Co.
- Dow Chemical Co.
- Esso Standard Oil Co.
- Firestone Tire & Rubber Co.
- Food Machinery & Chemical Corp.
- Foster Grant Co., Inc.
- General Chemical Div., Allied Chem. and Dye
- General Tire & Rubber Co.
- Goodrich-Gulf Chemicals, Inc.
  - B. F. Goodrich Co.
  - Gulf Oil Corp.
- Goodyear Synthetic Rubber Corp.
- W. R. Grace & Co.
- Great Southern Chemical Corp.
- Hercules Powder Co., Inc.
- Heyden Chemical Corp.
- Humble Oil & Refining Co.
- Koppers Co., Inc.
- Merck & Co., Inc.
- Midland Rubber Corp.
- Minnesota Mining & Manufacturing Co.
- Monsanto Chemical Co.
- Montrose Chemical Co.
- J. G. Mulligan & Co.
- National Lead Co.
- Edwin W. Pauley
- Petroleum Chemicals, Inc.
  - Cities Service Oil Co.
  - Continental Oil Co.
- Phillips Chemical Co.
- Publicker Industries, Inc.
- Shell Chemical Corp.
- Sinclair Refining Co.
- Standard Oil Co. of Calif.
- The Texas Co.
- U. S. Rubber Co.

See Louisville for

CREATIVE COOLING ENGINEERING

Louisville Cooler does satisfactory job at low cost for nationally known chemical manufacturer . . .



Louisville Surface Cooler has rotary shell and external water sprays.

KNOW THE RESULTS before you buy!

. . . cooling lumpy calcined material from 1800° Fahr. to 150° Fahr. for further processing. Gentle mechanical handling required to minimize decrepitation.

Each Louisville cooler is "*job-fitted*" to your special problem—to make your cooling operations effective—to assure dependability of performance that will make the cooler operation pay.

Call in a Louisville engineer for a complete cooling survey. Based on his experience he will recommend one of the three standard Louisville types, a modification, or an entirely new design. *The performance will be pre-determined.* You'll know the results before you buy . . . and the results *must* be better! Write for complete information today.

3 types of Louisville Coolers

- **Surface Cooler**
- **Water Tube Cooler**
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Over 50 years of creative drying engineering

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American Viscose Closes Marcus Hook Operations

Because the textile market is not offering enough business for all the existing capacity of the rayon industry, American Viscose Corp. has discontinued all commercial yarn manufacturing at its Marcus Hook, Pa., plant. Research facilities and other units at Marcus Hook serving the company's seven other rayon, acetate and cellophane plants will, however, continue to operate.

About 1,000 employees are affected by the move, but management has already put plans into effect that will provide as much financial protection as possible for all those with five or more years of service. The Marcus Hook plant is the corporation's smallest operation.

Cyanamid Dedicates Petrochemical Plant

The first production units at American Cyanamid's new Fortier plant near New Orleans, La., are now on stream. Present output is limited to sulfuric acid, oxygen and ammonium sulfate, but production of acetylene, hydrocyanic acid, ammonia and acrylonitrile is expected to begin shortly.

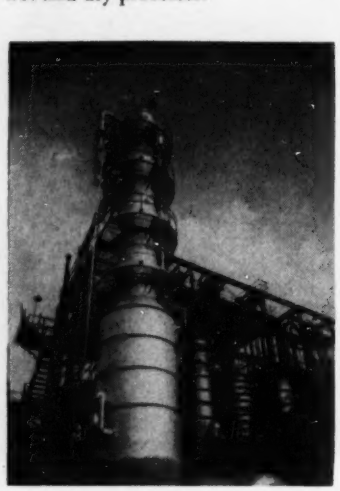
Begun just about two years ago, the plant was originally scheduled to have an ammonia capacity in the neighborhood of 150 tons a day. In November 1953, however, Cyanamid announced that it was planning to increase this capacity to more than 300 tons per day. Total cost is estimated at $52 million, $39 million having been spent as of the end of last year. Chemical Construction Co., a Cyanamid subsidiary, designed and built the plant.

High Efficiency Oil-Black Plant Opens

Boasting 60% carbon recovery and essentially 100% collection efficiency, Continental Blacks, Inc., has formally opened its $2.75 million oil-black plant at Ponca City, Okla. Daily capacity is between 120,000 and 140,000 lb. of HAF and SAF carbon blacks.

Nearly perfect collection efficiency is accomplished in a modern bag-filter unit, over 4,000 Orlon filter bags, each 5 inches in diameter and 10 ft. long. An identical unit is in operation at the Sunray, Tex., installation of Continental Carbon Co., an affiliate.

Feed to the plant is about 800 barrels per day of residual oil and 1.5 million cu. ft. of natural gas. This is cracked at about 2,500 F. in a refractory-lined furnace to form carbon black which is collected first in multi-stage cyclones, then in the bag-filter unit. Final processing consists of pelletizing, by both wet and dry processes.



New Plant Means More Plasticizers

Completion of a new production unit (above) at the S. Charleston, W. Va., plant of Carbide and Carbon Chemicals Co. increases substantially the availability of Flexol Plasticizer TOF—tri-(2-ethylhexyl) phosphate. Company spokesmen say that this will make its use possible in many more products.

Until now, TOF has been used principally in vinyl and rubber products. Its major important characteristics are resistance to embrittlement even at temperatures below −70 C., flame resistance, fungus resistance and resistance to water extraction. Also it is a superior dispersant for plastisol resins.

Chemical Engineering School Set for Israel

A big fund raising drive is now underway aimed at enlarging and modernizing Israel's Institute of Technology, Technion. And an integral part of the program is the establishment of an all-new school of chemical engineering to be named after the late Karl T. Compton, chairman of the corporation of the Massachusetts Institute of Technology.

Construction budget for this department is $930,000, 10% of which will be for pilot plants. Also included are 14 engineering and chemistry laboratories. Dr. Compton, just before his death, gave two gifts of $1,000, one for general use, the other specifically for the chemical engineering school.

The original Technion was built for a maximum of 300 students, now has 1,800. Many classes are held in aluminum huts. The new Technion, for which $20 million is needed, will be large enough to handle triple the present enrollment.

Air Reduction Ups Vinyl Acetate Aims

By both acquisition and new plant construction, Air Reduction Co., Inc., New York, N. Y., is bidding for a bigger slice of the various vinyl acetate markets. In a dual move, the company revealed that it has bought the Colton Chemical Co. of Cleveland, Ohio, and that it would build a 30 million pound per year vinyl acetate monomer plant at Calvert City, Ky.

Colton, which is expected to operate as a division of Air Reduction, now makes polyvinyl acetate emulsions (Vinac) for use in adhesives and coatings, and polyvinyl alcohol (Vinol) used in textile size, adhesives and molded articles. Both these lines need vinyl acetate monomer as a raw material. Other major Colton products are foamed urea-formaldehyde resins (Colfoam and Sno-Pak) and Microballons, small plastic hollow spheres used to reduce evaporation loss of stored crude oil.

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Cat Reformers

will be fired by

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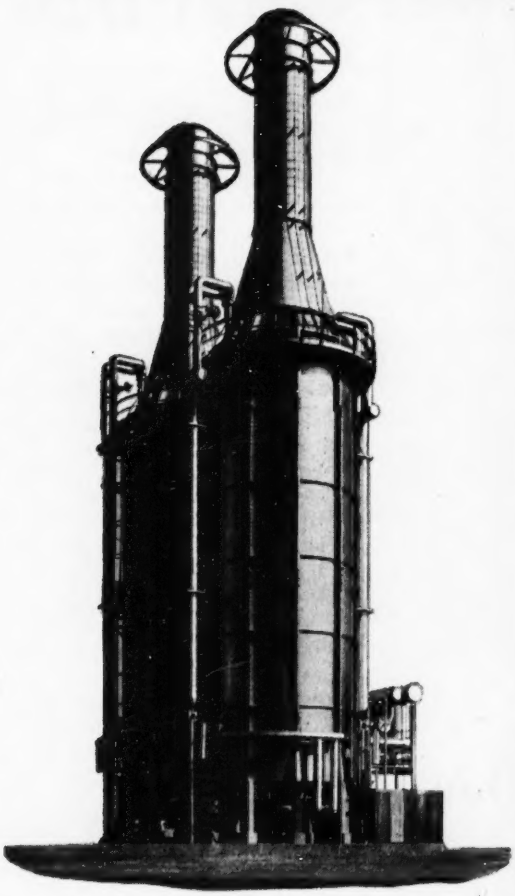

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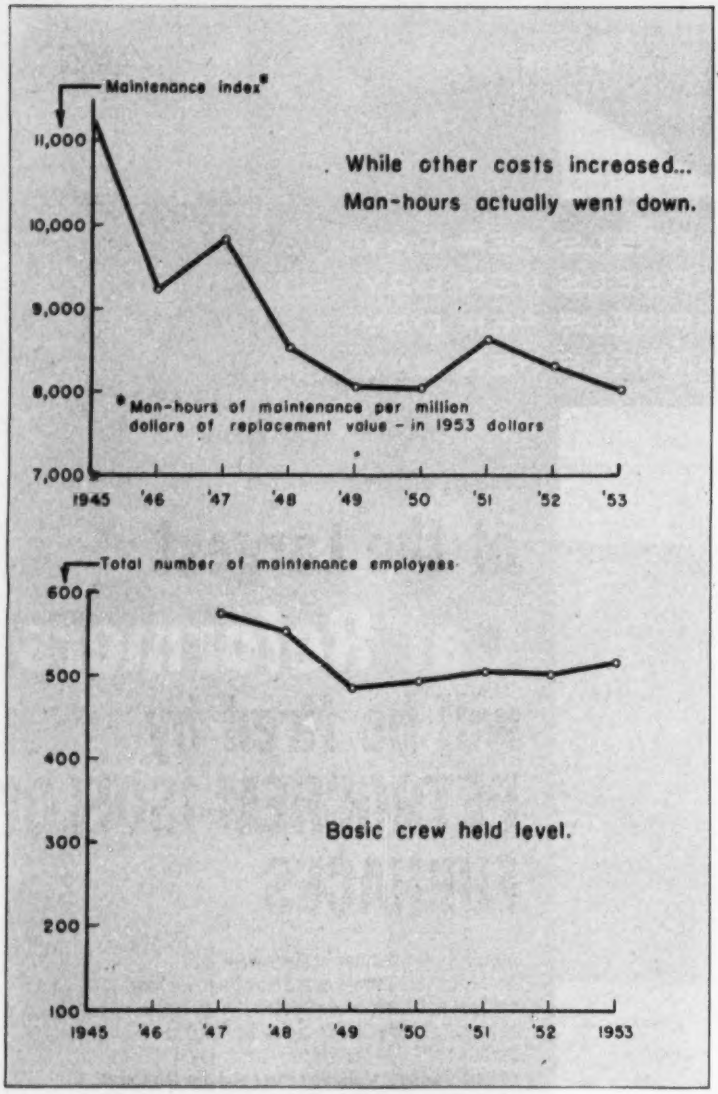


Clear demonstration of success. A four-point program to . . .

Keep Repair Man-Hours Down

Here's a plant that has been able to hold the line on maintenance labor when everything else was going up. That's news you may profit from.

Since the cost of labor is almost half the total of maintenance expense, control the number of maintenance men on your payroll. This is the method that General Petroleum Corp. (Torrance, Calif.) has been using for the past eight years to control maintenance charges.

The program has worked well. The charts above show the increased effectiveness of the maintenance organization since the program was started in 1945.* By using the yardstick of man-hours of maintenance per million dollars of plant equipment replacement value —in 1953 dollars—the effect of changing equipment costs and wage rates are obviated. The reduction in maintenance personnel is especially significant since it occurred during the time that the plant was expanding. Here are the highlights:

- Decide on a minimum crew to maintain the equipment satisfactorily.
- Keep accurate cost control records.
- Plan your work first thing in the morning. Schedule major shutdowns well in advance. Conduct pre-shutdown "skull" sessions.
- Delegate authority and responsibility for getting jobs done and in what priority.

▶ **Basic Crew Size**—General Petroleum first settled on the size of crew that they felt could maintain the plant satisfactorily. They reduced the crew to this number and then held it there.

Although a crew that is larger than necessary can be wasteful, it is just as uneconomical to try to operate with a crew that is too small.

For a definite starting point they decided that the basic crew should be able to turn around a major viscosity-breaker unit in five days, plus the minimum amount of standby and running maintenance at the same time. Certain jobs, such as lubrication of moving equipment, were transferred to the operating staff. Not only did this decrease the maintenance staff requirements but also the frequency of bearing-failure decreased.

▶ **Records and Controls**—Any quantity must be measured to be controlled. GPC had to set-up a new job-order and accounting system to fit in with this program. Work outlines were written for each job, listing all the work to be done by item in the proper trade category.

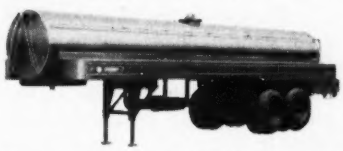
* It was explained in detail to the American Petroleum Institute, Refining Div., Houston meeting, May 11, 1954, by F. C. Smith, Jr., of General Petroleum Corp.

Anhydrous ammonia is hauled in this Fruehauf Truck-Full Trailer operating on the West Coast. Twin-cylinder Semi-Trailers have also been designed for the rapidly-growing liquid fertilizer industry, where Fruehaufs are extensively used because of their mobility, dependability, and economy.

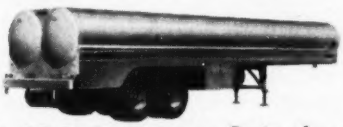
NEW TOOLS FOR INDUSTRY'S GROWTH!

Stainless Steel Acid Transports — For nitric acid, acetate solvents, acetic acid and anhydride, aluminum sulphate, ammonium chloride, hydroxide, nitrate, phosphate and sulphate, butadine, calcium bisulphate, formaldehyde.

Carbon Steel Acid Transports — Designed to haul oleum, acids and acid sludge. When lined with the proper substance, used to carry hydrochloric (muriatic), sulphuric, and other acids.



Insulated Low-Pressure Tank-Trailers — Designed to transport hot sulphur, latex, penicillin, paraffin, hot oil, wax, tallow, resins, tar.



Twin Cylinder Tank-Trailers — Designed to haul propane, butane, anhydrous ammonia.

Insulated Hot Commodity Transports — Engineered to haul asphalt, hot oil, crude oil, road oil, tar, pitch, tallow, wax, paraffin, resin, glue.

Newly-Developed Chemical Trailers By Fruehauf Move Raw Materials and Finished Products Faster!

MANY FIRMS in the chemical industry and allied fields have greatly increased their scope of operations by the use of specialized Fruehauf chemical Trailers.

They have utilized Fruehauf bulk transports for fast movement of raw materials in full or partial loads, wherever and whenever needed, eliminating costly delay, reducing the need for expensive inventories of supplies, and increasing production efficiency.

And they have found that Fruehauf designs the exact Trailer needed to ship finished products — either in bulk, drums, or packages, however needed — directly to customers or distribution points. *Direct* Trailer shipment removes costly in-between delays, re-loading, and re-handling.

If you are growth-minded and cost-conscious, Fruehauf Trailers — the finest built anywhere — are probably the exact tools you need for greater expansion and economy in your business. It can pay you to investigate!

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☆ *To send this coupon, simply attach to your company letterhead, sign your name and mail—you'll get action!*

Overtime is authorized only when it actually saves the expense of keeping a unit shut down. Monthly maintenance expense reports keep all the operating supervisors, refinery engineers and maintenance supervisors on their toes.

▶**Planning**—Schedules are set up three months before the end of the year for all major shutdowns during the next year. And meetings prior to each shutdown provide an opportunity to acquaint all concerned with what must be accomplished. Questions are answered and agreement is reached on possible differences which might arise while the work is in progress.

All major construction work and most of the minor construction jobs in the plant are contracted. The plant crew uses minor construction work to fill in the valleys of the work schedule, if any.

Operating with a minimum crew also means that the work is always pushing the men. Some jobs are more important than others and this calls for a priority system.

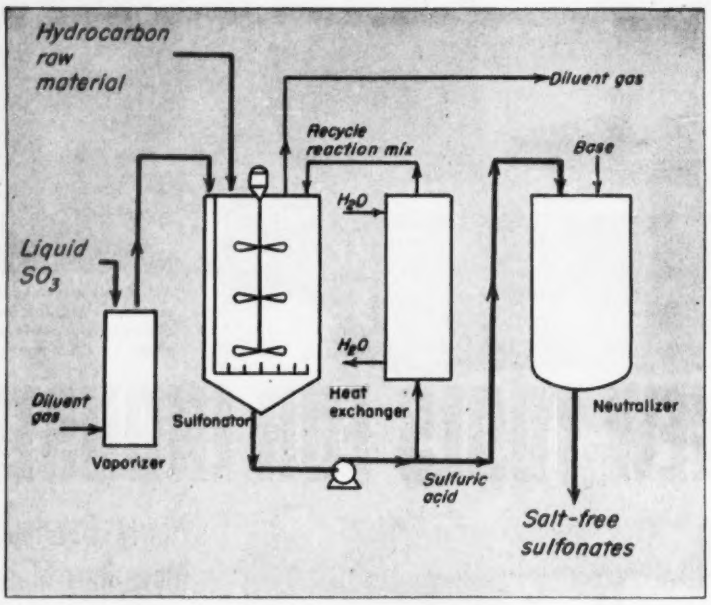
At the end of each day the maintenance control engineer prepares a daily 'hot sheet." At 6 a.m. each morning the night superintendent checks with stillmen at each unit and lists any emergency work which has arisen during the night.

These two lists are discussed by the maintenance control engineer and the operating superintendent before 8 a.m. and by 8:30 a.m. all maintenance foremen are briefed on priorities for the day.

▶**The Human Element**—Plant operating personnel must be included within the area of decision on maintenance problems. In this program they decide which work is to be done and which should be done first.

The maintenance personnel determine how to do the job, who is to do it, and how many people are required. These decisions can be made best in the field offices. Field supervisors are charged with responsibility and are given authority for carrying out their decisions.

This makes the entire program a continuing challenge to all who are associated with maintenance problems.



Processing With Liquid SO_3

. . . Brings both sorrow and smiles. Handling and other problems are rough, but users of the new reagent claim it has an edge over other sulfonating methods.

Sulfonation is not exactly a new process, it's been around just about as long as sulfuric acid itself. But recently a new wrinkle has proved itself on a commercial scale. The new twist: sulfonating with liquid sulfur trioxide.

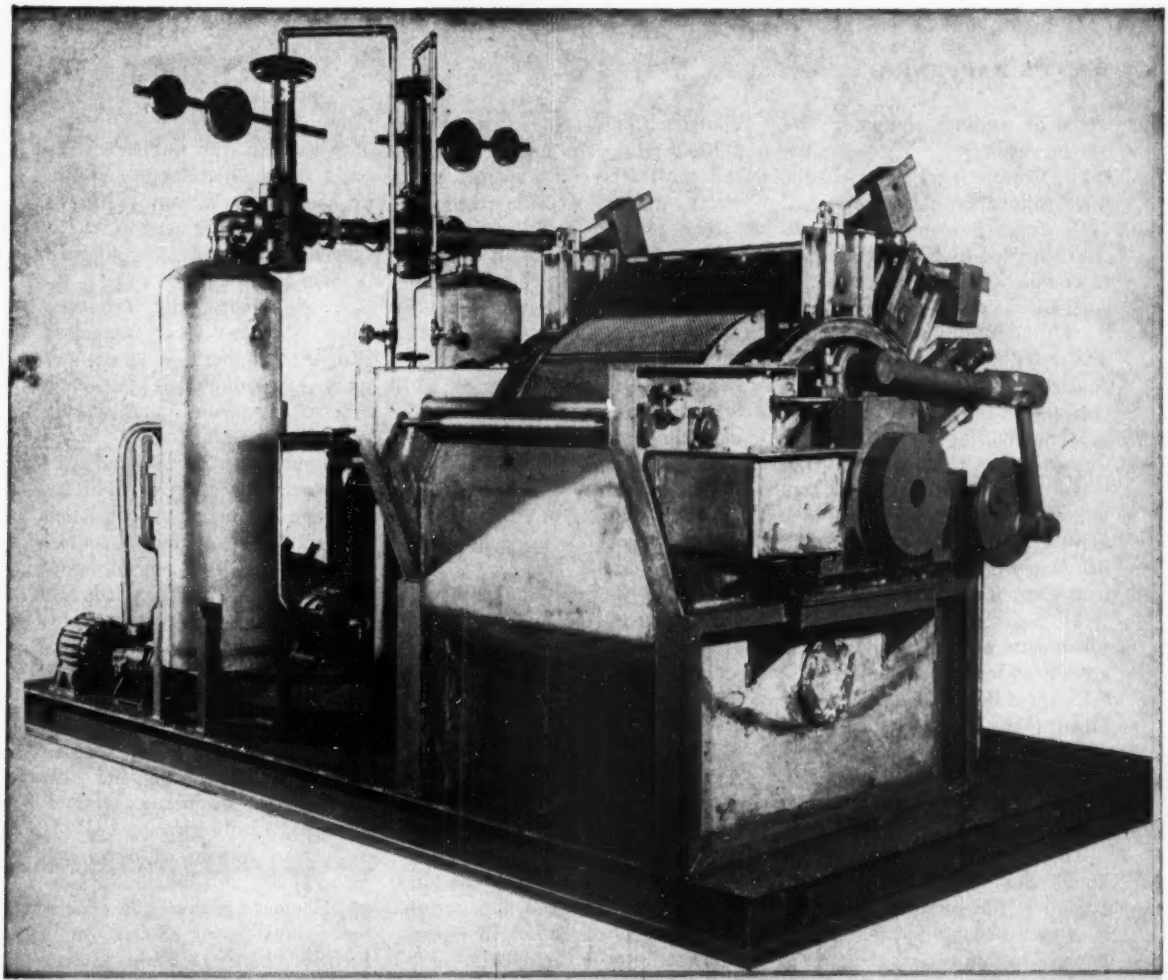
Since 1948 when the General Chemical Div. of Allied Chemical and Dye Corp. first introduced Sulfan, its stabilized, liquid SO_3, many chemical companies have shown an interest in using it to replace the usual sulfonating agents—sulfuric acid, oleum and chlorosulfonic acid.

▶**Salt-free Detergents**—Two of the latest to do this on a commercial scale are Ninol Laboratories, Inc., Chicago, Ill., and Treplow Products Inc., Paterson, N. J., both producers of anionic alky-aryl sulfonates—among other products.

This type of sulfonate is used in most of the synthetic detergents in use today. Claim of both Ninol and Treplow is the absence of sodium sulfate salts in their products. Lack of these salts makes for a more active product, and permits the formulation of more concentrated detergents.

▶**How They're Made**—The new method short-circuits harmful salt production by way of a mole-to-mole reaction—each mole of sulfur trioxide reacts with a mole of the aryl alkylate. The reaction yields no spent acid to be neutralized and only a negligible amount of sodium sulfate salts. In addition, it is speedier than the conventional, thus cutting processing time down considerably.

The reaction is more complete, yielding a more active product; and, since the volume of liquid SO_3 needed for a given sulfonation is less than the volume of oleum that



HIGH SUBMERGENCE STRING DISCHARGE CONTINUOUS VACUUM FILTERS

Industries using standard design drum and disc type continuous vacuum filters are often interested in a specialized Eimco filter to develop a new product, increase production or complete a research project.

Such was the case of the customer who ordered the machine shown above. It is a high submergence (55%) stainless steel drum type filter equipped with compression rolls, string discharge and wash headers.

This unit uses Eimco "pin" type agitator and the vacuum line is equipped with vacuum regulating valves. All necessary operating equipment including receivers, motors, pumps, etc., are mounted in standard Eimco package arrangement on a fabricated steel sub-base with piping in place and wiring to a control panel.

Call an Eimco Engineer and let him help you solve your filtration problems (no obligation to you). Eimco has been serving the processing industries for more than half a century.

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You Can't Beat An Eimco

would be required, equipment size can be smaller.

▶ **The Conventional Route**—In the usual sulfonation a large excess of 20% oleum is required. This excess is needed to drive the reaction to completion for, as the reaction goes, a mole of water is formed for every mole of sulfonate produced. The water, in turn, dilutes the acid. And once the pH drops below a critical level the reaction stops.

In neutralizing the sulfonic acid formed in the reaction, spent acid is also neutralized and the salt content of the product may run as high as 60%. Settling out the spent acid before neutralizing can slice the salt content to about 15%.

To make salt-free sulfonates by this process, it is necessary to go to a costly solvent extraction setup.

▶ **Plenty of Bugs**—Of course, a mere listing of the advantages of the new process doesn't tell the whole story—not by a long shot. Liquid SO_3 can be as hard to handle as a kite in a hurricane.

The only commercially available liquid SO_3, General Chemical's Sulfan, is the gamma form stabilized by less than 0.5% boron compounds—in sulfonations these act as catalysts. Give it a chance to come in contact with atmospheric moisture and it's liable to polymerize to the explosive, asbestos-like alpha variety. In addition to being unpredictable, corrosion is a problem.

A much stronger reagent than oleum, liquid SO_3 has a high heat of reaction, hence, charring, discoloration or even decomposition of the raw material is an everpresent danger when using it. Reactions are instantaneous and highly exothermic—and may also bring rapid and extensive changes in such properties of the reactants as viscosity.

A high degree of engineering ingenuity in both process and equipment design is called for to solve these problems.

▶ **Swatting the Bugs**—The Treplow process for dodecyl benzene sulfonate is fairly typical of the processes using liquid SO_3.

A metered flow of Sulfan is pumped into a vaporizer where it is heated, and the resulting vapor is diluted with dry, compressed air—in a 1-to-9 ratio. The diluted gas enters the reactor via a sparger and reacts with the dodecyl benzene.

The reaction mixture continuously circulates through an outside, shell and tube heat exchanger. The diluent air is taken off at the reactor.

When sulfonation is complete, the sulfonic acid is sent on to the neutralizer. Either caustic or triethanol amine is used to neutralize, depending upon which sulfonate is in demand at the time.

Final product is shipped either as a liquid, as flakes or in a powder form. Shipment is made in resin-lined steel drums.

To beat the corrosion problem, virtually all of Treplow's equipment is stainless steel. Welded fittings are used wherever possible; gaskets, where necessary, are of Teflon. Neutralization tanks are glass-lined.

Efficient mixing and proper dispersion of the SO_3 in the reaction vessel are essential to control the rate of reaction. Treplow achieves this by using a specially designed sparger inlet for the diluted SO_3 vapor, an agitator and a powerful stainless steel pump, which moves the reaction mix through the heat exchanger—recirculating the entire batch every few minutes.

Treplow uses the same set-up to sulfonate other materials, too. For example: lauryl alcohol, used in shampoo preparations.

▶ **Others Are Similar**—The processes of other sulfonators are similar to Treplow's. Each, of course, has one or more features which set it apart.

Ninol, for example, is believed to be using dry nitrogn, instead of air, to dilute the vaporized SO_3. In General Chemical's own pilot plant both sulfur dioxide and air have been used for the same purpose.

Other variations were incorporated into the pilot plant study conducted by Continental Oil, a supplier of dodecyl benzene.

▶ **Trying to Go Continuous**—The batchwise nature of the present operation has been one of the factors causing the bigger detergent makers to shy away from it. With this in mind, Continental, General Chemical and the Girdler Co., equipment manufacturers, have all been working with Girdler's Votator, a combination reactor and heat exchanger, in an attempt to put the reaction on a continuous basis. Results so far, while encouraging, merit more study.

A while back, the Tennessee Corp., Atlanta, Ga., announced that it had found a continuous method of sulfonation which also bypassed the oleum route using instead "a combination of sulfur-containing materials produced in its own adjacent acid plants." This announcement brought speculation that converter gas from a contact sulfuric acid plant, generally containing about 10% SO_3, a little SO_2 and air, was the sulfonating agent.

▶ **Abroad, Too**—This method is now receiving active attention from a number of European sulfonators. They are exploring the possibilities of using a gas stream of approximately 8% SO_3, 2% SO_2 and 90% air to replace oleum and chlorosulfonic acid as sulfonators.

Overseas interest in direct sulfonation has also influenced General Chemical to license its process for manufacturing Sulfan to a French concern, Etablissements Kuhlmann.

▶ **A Prize and a Price**—Sulfonation is a step in the preparation of literally thousands of products, from lubricant additives to pharmaceuticals. The market for synthetic detergents alone is big (over 2 billion pounds last year) and growing (almost 20% bigger than in '52).

Just about every user of the direct sulfonation process has tried to sulfonate many other materials in addition to those now on a commercial basis. All agree that there is a fine future for the method.

However, any path to a process using liquid SO_3 is strewn with traps for the unwary. More than one company has stubbed its toes and hesitated and at least one, Vosco Industrial Chemical Products, Ltd., of Montreal, Can., once in commercial production, has now fallen by the wayside. Also, recent reports, neither confirmed nor denied by the company, hold that the Tennessee Corp. has dropped its method and is now using oleum.

Why is "Lead" used to control Sulphuric Acid Corrosion?

For centuries "Vitriol" was hard to harness.

But in 1746, Roebuck of Birmingham found how to tame this workhorse of the chemical industry. He used lead.

Lead is still the first metal to look to for control of sulphuric acid corrosion. It's basic in producing H_2SO_4. It's basic in handling H_2SO_4. It's basic in concentration, recovery and storage of H_2SO_4.

Lead should come first to mind in the control of corrosives because:

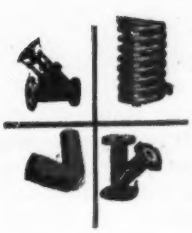
1 **Lead makes and wears its own protective armor.** Repairs it, too. In contact with H_2SO_4 (and many other acids) it makes for itself an impervious, insoluble, self-mending coating which only an abnormal condition destroys.

2 **Lead cooperates when it is fabricated.** No common metal is easier to work. Even in the field you can easily melt and cast it . . . mold and shape it . . . cut or form it. You can "burn" (weld) lead to lead with simple equipment. You can bond it to steel or copper.

3 **Lead is economical and available.** Its cost per pound is low. It costs little to maintain. When its application has run its course, lead has high salvage value...often a substantial percentage of original metal cost.

WHAT GOES FOR LEAD AND H_2SO_4 GOES FOR LEAD AND HUNDREDS OF OTHER CORROSIVES

When you think of Lead . . . think of National Lead



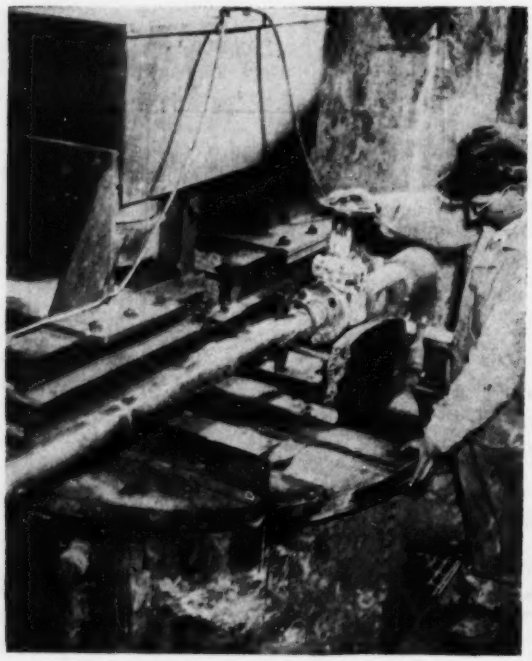
National Lead puts lead in your hands in all the grades and forms you may require. National Lead provides all common mill shapes and sizes and forms . . . sheet, pipe, fittings, valves. Or you can have National Lead "tailor-make" lead equipment for you.

So put National Lead first in your thinking when you want to combat corrosion. Call on National Lead for technical assistance. Ask for a copy of the new booklet on "Chemical Lead Products."

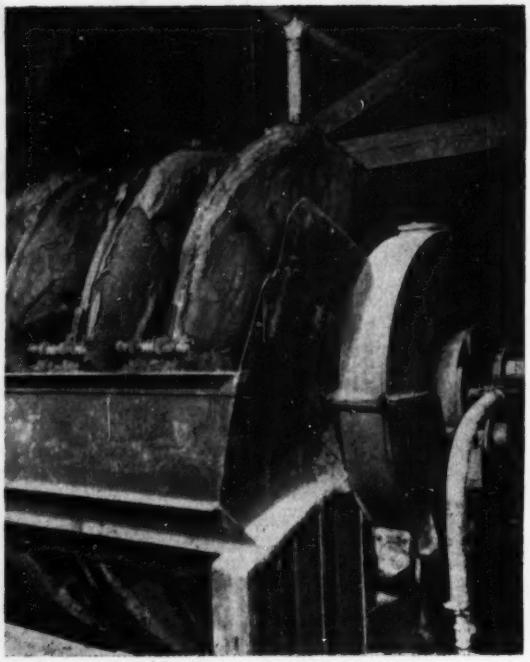
National Lead Company

New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 80; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Limited).

*Reg. U.S. Pat. Off.



OXIDATION of gelatinous precipitate improves . . .



FILTRATION rate of ferrous hydroxide slurries in . . .

New Way to Tame Balky Separation

Rapid filtration—at low oxidation levels—is crux of continuous neutralization process. New technique promises simple, cheap processing of acid liquors.

Partial air oxidation of precipitated gelatinous ferrous hydroxide makes for easy filtration in a new process designed by A. O. Smith (Milwaukee) and Eimco Corp. (Salt Lake City). Developed primarily to cope with the problem of waste pickle liquor disposal in steel plants, the process also offers an out to other industries which are plagued with the handling and filtration of gelatinous slurries.

▶ **Filterable Slurry**—Here's what Smith-Eimco investigations have brought to light:

• Complete neutralization of acid liquor is possible in less than 15 min.—using a simplified process. At the same time the neutral precipitate is made readily filterable merely by oxidizing 2 to 5 percent of the iron. This is done by direct introduction of air into the acid-lime slurry.

• Optimum filter cake thickness—1¼ in.—occurs at the 2 to 5 percent oxidation level. Filtration rates at this level are equivalent to those at 50 percent oxidation (which requires a time of ½ to 2 hr.).

These factors obviate the non-filterable, gelatinous slurry which, heretofore, has been a major problem in economical filtration and cake discharge.

▶ **Continuous Neutralization** — Treating the question as one of waste disposal, the process hinges on continuous neutralization of spent pickle liquor.

Pickle liquor from batch or continuous tubs flows to a waste acid holding tank (capacity: one day's production). Acid feeds continuously, through a control valve, to a reactor designed for a given retention time.

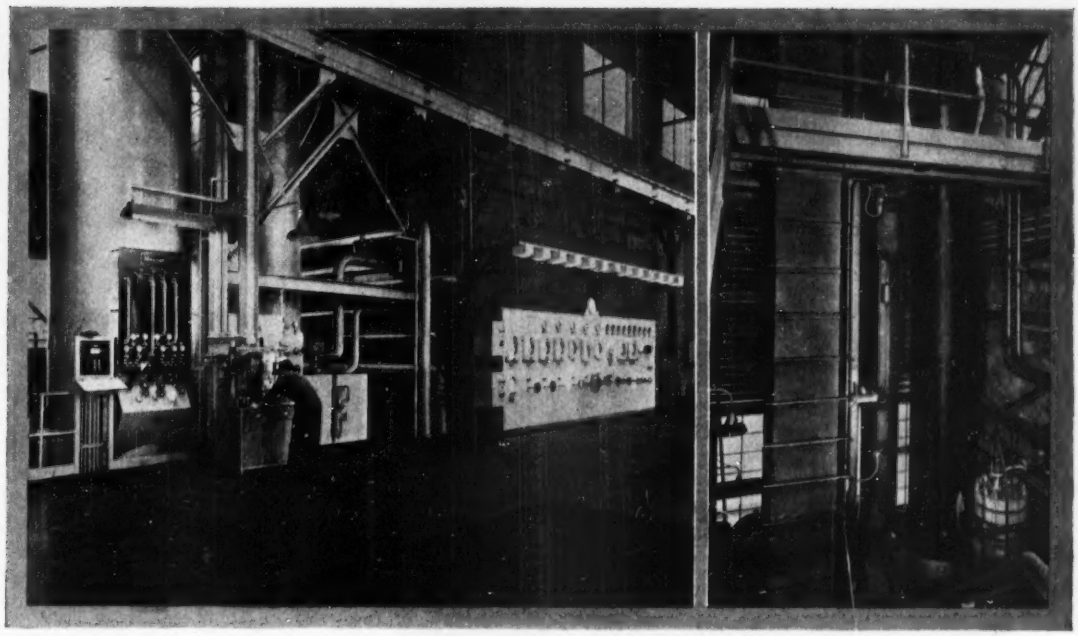
Milk-of-lime flows at a constant rate into the reactor. The resultant acid-lime slurry undergoes high speed agitation. Simultaneous addition of compressed air (entering below the diffuser plate under the agitator impeller) provides intimate contact between gas and slurry.

The degree of neutralization in the reactor is regulated by a conductance meter. If soluble salts form, a pH meter is substituted. Meter readings determine the control required for constant pH. Retention time—usually 15 min.—determines the percent conversion of ferrous salts to ferric.

From the reactor, the slurry flows to a disk filter where solids and neutralized liquor are separated. Sludge is dewatered to a cake mois-

excess H_2 to NH_3

by Casale ammonia synthesis



55 Tons per day of liquid anhydrous Ammonia is being produced at this new plant of the Pennsylvania Salt Manufacturing Company at Wyandotte, Michigan. The Hydrogen is a by-product from Pennsalt's adjacent chlorine plant.

The photographs show the Liquid Air Plant and the control board in the compressor building; also, the Casale ammonia condenser, deoxidation reactor and convertor.

For a general description of this installation, designed, constructed and licensed by Foster Wheeler:

write for HE—4-54

FOSTER WHEELER CORPORATION

165 BROADWAY NEW YORK 6 NEW YORK

ture content of 50 to 60 percent. Solids are easily handled and stable enough for long-distance truck transportation, if necessary.

The filtrate (pH 7.5) contains no suspended solids. Part of it returns to the lime slaker; the remainder is acceptable for municipal sewers or discharge to natural streams.

▶ **Slurry Make-up**—Confirming earlier reports, recent investigations show that neutralized filtrate can be used as make-up for milk-of-lime slurry. At one of A. O. Smith's installations, at least 80 and up to 100 percent of make-up water is neutralized filtrate. Complete lime reaction and best pumping slurry require a maximum lime concentration of 2¼ lb. per gal.

Temperature control during neutralization plays an important part in the process, affecting operations and equipment. In the range of 105 to 120 deg. F. you get an optimum combination of filtration rate and media life. Scaling of pipes and connections (due to build up of $CaSO_4$ precipitated during filtration) is minimized.

▶ **Sole Chemical Cost**—The alkaline neutralizing agent, representing the only chemical cost in the process, was the subject of intense study. Time and completeness of reaction, effect on filtration, ease of handling and availability were factors considered in the final choice.

In evaluating eight common agents for basicity values (g. equivalent CaO per g. of material) and cost per ton, investigators came up with two choices—carbide lime and high calcium quicklime.

The flexibility of the operation was tested on pickling processes using acids other than sulfuric. Results: continuous neutralization is effective with hydrochloric, hydrofluoric and nitric acids.

▶ **Operation Economy**—Until now, almost all solutions to the problem of pickle liquor disposal have had a common denominator—high cost, low (if any) profit.

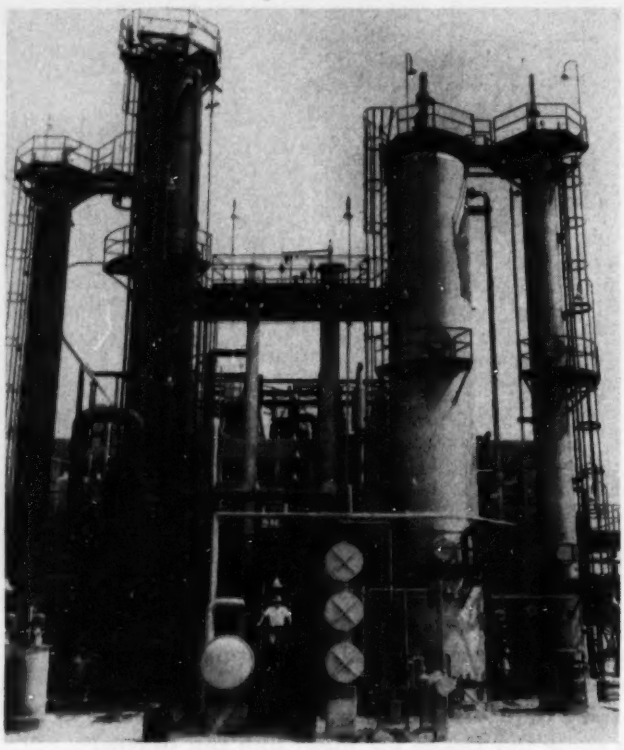
The trouble with cheap or even cost-free methods has been the production of effluents polluting land and stream.

The tack taken by A. O. Smith and Eimco is that it's cheaper—in the long run—to economically dispose of waste liquor than it is to recover it. To prove their point, the two companies have developed a process having:

- Easily disposable solids with legally sewered effluents.
- Low capital investment and operating costs. A 30,000 gal. capacity plant—per 16-hr. day—has an installed cost of $56,425; operating cost per week is $2,742.60.
- Small space requirements.
- Simplified flow sheet and operation.
- Utilization of plant waste products in neutralization.
- Wide range of application with respect to type of spent liquor and plant capacities.

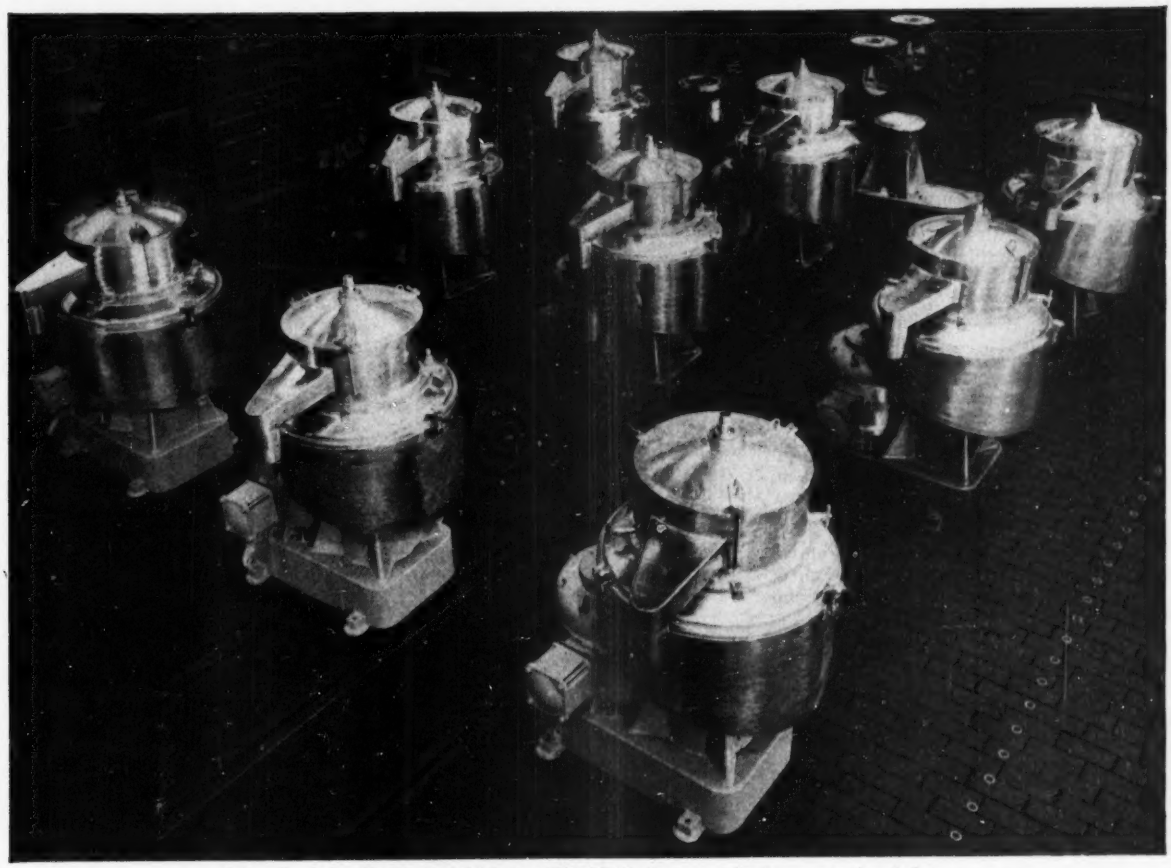
Several plants are already cashing in on the continuous neutralization method, among them Bliss and Laughlin (Detroit) and Globe Steel Tubes (Milwaukee). And other jobs are under way.

With much to be gained, it looks like the metal industries feel they have an edge in the fight against pollution by using the Smith-Eimco process.



New Texas Ethylene Oxide Plant

First U. S. company to use the direct oxidation process for ethylene oxide developed by Scientific Design Co. (Chem. Eng., Feb. 1954, p. 136), Allied Chemical & Dye's Nitrogen Division has begun operations at its new $5 million Orange, Tex., plant. Ethylene glycol and diethylene glycol are also being produced. And at the opening, plans were revealed for another new unit at Orange, this one to make mono-, di- and triethanolamines by reacting ethylene oxide with ammonia. Completion is expected within a year.



These Particular Sharples Parallel Drive DH-2 SG Nozljectors are for the concentration of gluten.

ANOTHER BATTERY OF HIGH CAPACITY CONCENTRATORS!

Up to 58% greater capacity with no increase in bowl size or speed ... and no increase in power consumption per unit of throughput. That is the big story of the Sharples PARALLEL DRIVE DH-2 SG Nozljector.

How is such outstanding performance possible?

• A detailed study of the theory of sedimentation, coupled with extensive field tests by Sharples engineers, determined the proportions of the basic Nozljector bowl that would provide up to 58% increase in capacity ... with long runs between bowl cleaning.

• To make full use of this new high capacity bowl, Sharples designed a rugged spur gear PARALLEL DRIVE capable of transmitting up to 50 H.P. input—a drive that will take heavy duty service with minimum wear and maintenance.

• The PARALLEL DRIVE DH-2 Nozljector is available as a separator or as a concentrator. All models are of sanitary construction.

What does this mean to you? No longer is input power the factor that limits throughput capacity for solids concentration or liquid phase separation. The Sharples PARALLEL DRIVE DH-2 Nozljector gives you both ... efficient use of power input up to 50 H.P., plus over 50% greater capacity in the same size centrifuge.

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Convention Calendar

Western Packaging & Materials Handling Exposition, Civic Auditorium, San Francisco, Calif., August 17-19.

American Institute of Chemical Engineers, national meeting, Hotel Colorado, Glenwood Springs, Colo., Sept. 12-16.

First International Instrument Congress and Exposition, including many technical sessions, Philadelphia Museum and Convention Hall, Philadelphia, Pa., Sept. 13-25.

Chemical Market Research Association, annual resort meeting, Equinox House, Manchester, Vt., Sept. 20-21.

Technical Association of the Pulp & Paper Industry and Canadian Pulp & Paper Association, joint symposium on "Fundamentals of the Paper Machine," Institute of Paper Chemistry, Appleton, Wis., Sept. 20-24.

Industrial Packaging and Materials Handling Engineers, ninth annual exposition, Chicago Coliseum, Chicago, Ill., Sept. 28-30.

Eighth National Chemical Exposition, Chicago Coliseum, Chicago, Ill., Oct. 12-15.

National Industrial Conference Board, third annual conference on Atomic Energy in Industry, Hotel Commodore, New York, N. Y., Oct. 13-16.

National Safety Council, 42nd congress and exposition, Conrad Hilton Hotel, Chicago, Ill., Oct. 18-22.

West Coast Refiners Spend to Beat the Smog

Smarting under statements—official and unofficial—blaming them for dragging their feet in complying with regulations of the Los Angeles County Air Pollution Control District, a number of West Coast oil companies have issued statements telling the public just how much they've spent to curb air pollution. Richfield Oil Corp., General Petroleum Corp. and Union Oil Co. of Calif. were perhaps the most vocal.

Most of the controversy arose over the District's Rule 56, adopted in April 1953. It requires that all containers with capacity in excess of 40,000 gal. and used to store gasoline or other petroleum distillates must be equipped with either a floating roof or a vapor recovery system. That's because refinery storage was felt to release unsaturated hydrocarbons, which have been blamed as major contributors to eye-smarting and crop-damaging elements in smog—supposedly by their photo-oxidation in sunlight.

Rule 56 set up a 24-month schedule for compliance, with different deadlines for different sizes of tanks. When the rule was announced, it was said that 769 tanks in Los Angeles County would come under it, but that all but 495 had already been adequately dealt with voluntarily.

Stressing the voluntary aspect, Richfield stated that it has spent nearly $6¾ million on smog control equipment, starting in 1923. Most of this—$4,241,456—has been spent for hydrocarbon evaporation control: vapor recovery systems, floating roof tanks and open sump elimination. About $2 million of the $40 million construction program just completed at the company's Watson, Calif., refinery has been spent on air pollution control equipment, including a $538,000 electrostatic precipitator to recover catalyst dust.

Soon afterward, General Petroleum announced that it had spent $1.5 million on smog control since 1946 and is ahead of schedule on Rule 56. About the same time, Union said it had expended $5 million to control hydrocarbon emission in the county.

New Coloring Process Eliminates Use of Dyes

After 12 years of trying, a Hungarian chemical engineer, Karoly Bene, claims to have succeeded in dyeing wool without dye. Experiments in Hungary are said to have reached a stage where ten shades can be manufactured and large scale production has begun at the Worsted Spinning and Weaving Factory.

The traditional method of dyeing wool is essentially an acid process, followed by other treatment including two to three hours of boiling. The new method is a cold-dye that does away with boiling.

Material is treated with sodium nitrite and acid, making the thread so sensitive that it is receptive to coloring by an organic chemical solution. The treatment is finished off by use of a developer containing metallic salt.

According to the newspaper *Esti Budapest*, not only does the process save dye—which Hungary now has to import—but it improves the quality of the wool. Elasticity is said to be increased by 40%, tensile strength by 35%.

Tide Water Plans All New Oil Refinery

The biggest U. S. petroleum refinery to be built from the ground up will be constructed by Tide Water Associated Oil Co. in either southern New Jersey or near Delaware City, Del. The 100,000 barrel a day plant will supplant the companies 87,500 bpd. refinery at Bayonne, N. J. which is scheduled for gradual shutdown over a two-year period.

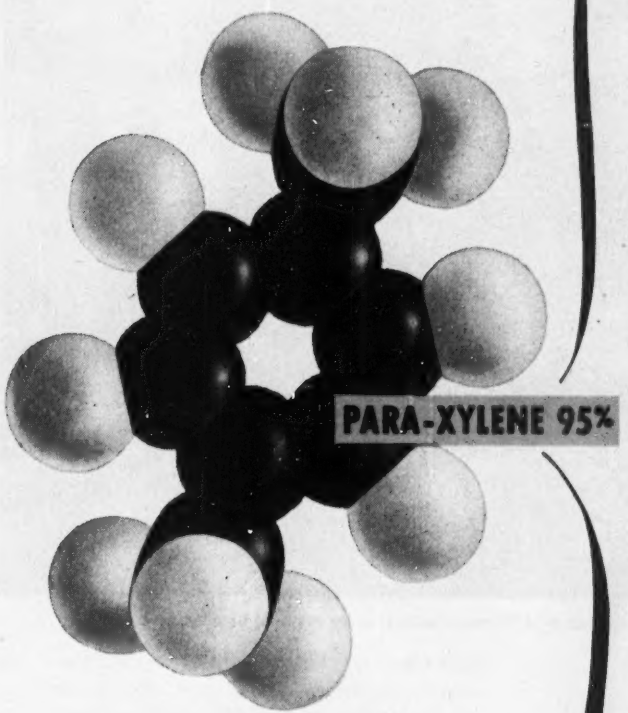
Reason for the move is that the Bayonne location is completely unsuitable for an expanded or even modernized refinery. There's not enough land area and local taxes would probably rise from $1.8 million to about $3 million annually if the modernization plan envisaged by Tide Water were carried out. No area of less than 750-1,000 acres is being considered as a new site. The present refinery is situated on only 236 acres.

The future of the Bayonne refinery's 1,400 employees is still uncertain, although this is one of the factors being considered in selecting a new plant site. As for equipment, little, if any, is expected to be moved from Bayonne, most of it being too old.

Oronite
PARA-XYLENE 95%

has many potential uses in chemical synthesis

This important chemical may be oxidized to terephthalic acid, a new dibasic acid useful as a chemical intermediate and in the production of polyesters, polyamides, and other high polymers. Inquiries welcomed.



Chemical Synthesis Possibilities

Process	Product	Usage
Oxidation.	Terephthalic acid.	Formation of polyesters, polyamides, etc.
Oxidation.	Para-toluic acid.	Synthesis of dyes.
Oxidation.	Para-tolualdehyde.	Condensation with polyvinyl alcohol for adhesive resin.
Oxidation.	2, 5-Dimethyl-hydroquinone.	Stabilizing agent.
Oxidation.	Terephthalal-dehyde.	Resins by condensation with diamines or sodium acetate.
Oxidation and chlorination.	Tetrachloro-terephthalic acid.	Flameproof textiles.
Oxidation and chlorination.	Tetrachloro-para-toluic acid.	Alkyd resin modifier.
Chlorination.	Tetrachloro-para-xylene.	Dielectric, heat transfer medium.
Chlorination and hydrolysis.	Para-xylyl alcohol.	For xylyl phosphate. Waterproofing agent. Cellulose ethers.
Chlorination hot or in ultra violet light.	Para-xylyl chloride.	Lachrymatory.
Dichlorination at boiling or in ultra violet light.	Para-xylylene chloride.	Synthesis.
Chlorination and hydrolysis.	Para-xylylene glycol.	Modification urea - formaldehyde resins.
Chlorination in dark with iodine or iron as catalyst.	2-Chloro-para-xylene and 2, 5-Dichloro-para-xylene.	Solvent and/or intermediate.
Chlorsulfonation and reaction with ammonia.	Para-xylene 2-sulfonamide.	Aldehyde resins. Cellulose acetate solvent.
Nitration.	2-Nitro-para-xylene.	Solvent.
Nitration and reduction.	Para-xylidine.	Dyestuffs.
Dinitration.	2, 6-Dinitro-para-xylene.	Dye synthesis.
Sulfonation.	Para-xylene 2-sulfonic acid.	Intermediate.
Sulfonation.	Para-xylene 2, 5-disulfonic acid.	Dyestuffs.
Sulfonation and caustic fusion.	Para-xylenol (2, 5-xylenol).	Making dimethyladipic acid, antiseptics.
Acetylation in presence $AlCl_3$	2-Para-xylyl-methyl ketone.	Perfume bases. Pharmaceuticals.
Ethylation and dehydrogenation.	Vinyl para-xylene.	Molding compounds. Synthetic rubbers.

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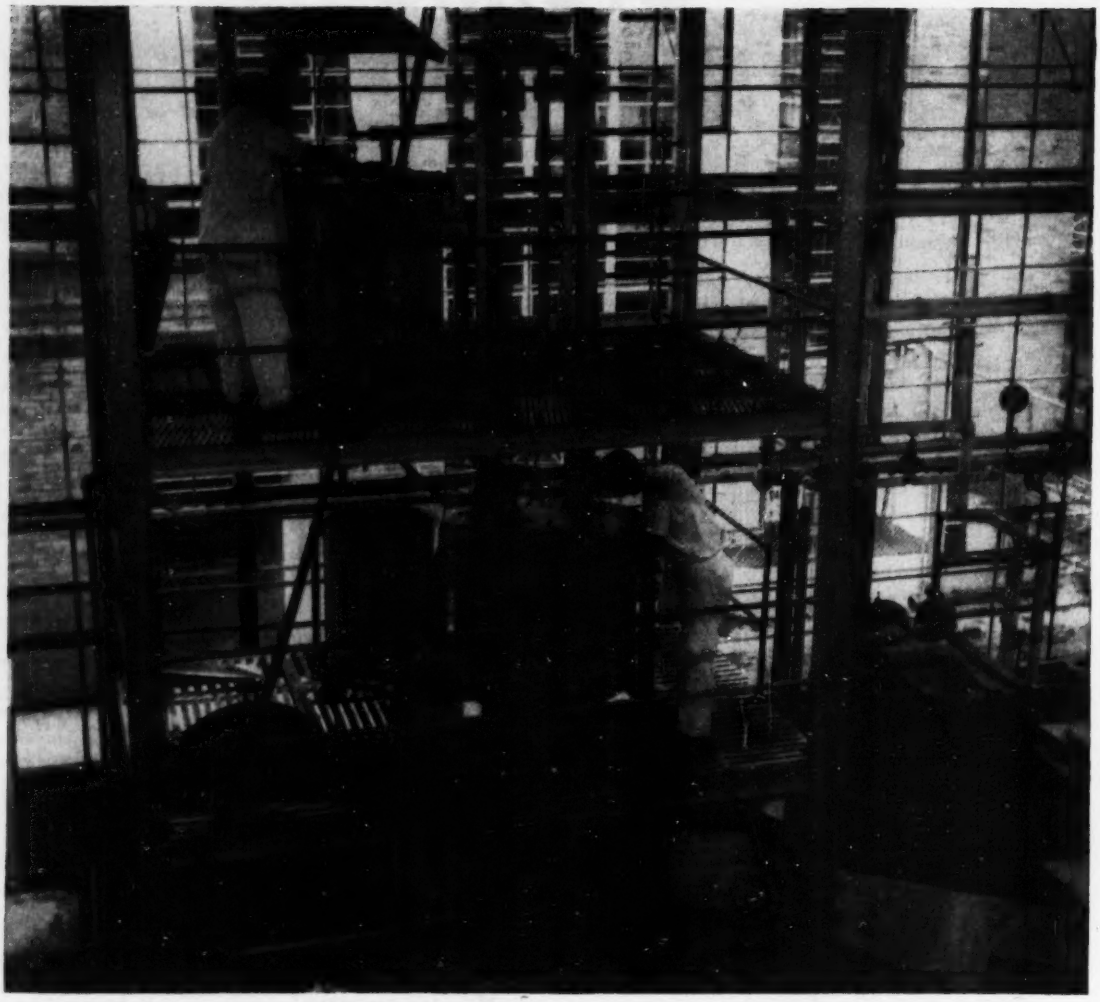


EXTRACTION of thyroid with alcohol. This unit operation at Warner-Chilcott is an example of what's . . .

Inside New Pharmaceutical Plant

Warner-Chilcott Laboratories has just completed a $2-million extension to its Morris Plains, N. J., pharmaceutical plant.

The addition—which triples the manufacturing facilities—is part of a consolidation program. Eventually most of the domestic drug production operations of the parent company, Warner-Hudnut, Inc., will be centered at Morris Plains.

Among the major products produced by Warner-Chilcott are: antacids; laxatives; a drug for reduction of blood pressure; a thyroid extract; an anti-asthmatic; and a drug for treatment of Parkinson's disease.

Warner-Chilcott places the emphasis on unit operations, not chemical synthesis, in making most of these products. The raw chemicals are purchased from bulk drug and chemical manufacturers, analyzed for purity, and then processed on modern equipment.

Some typical examples:

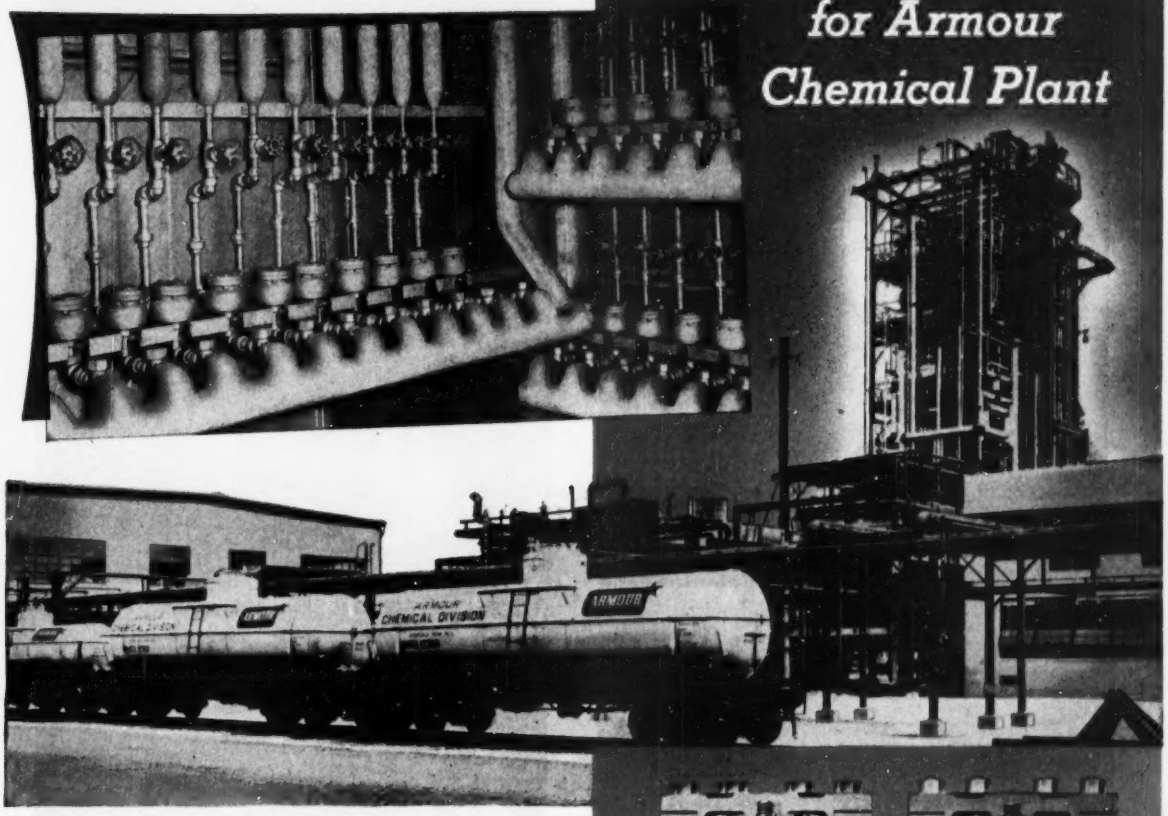
• To make a thyroid extract, animal glands are purchased, and the fat extracted with alcohol. The extract material is dried, formed into tablets and packaged.

• For an antacid, pure sodium citrate and sodium bicarbonate are purchased, blended and then fed into automatic packaging machines. Blending takes place on the second floor of the plant. The batch from the blender is charged directly, through a flexible hose, to a packaging machine on the first floor.

Continued on page 136

NICHOLSON TRAPS SELECTED

for Armour Chemical Plant



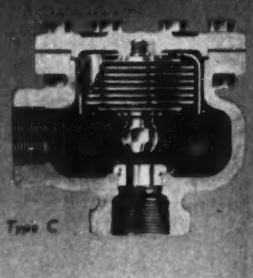
Above, new McCook, Ill., plant of Armour and Company's Chemical Division. Nicholson steam traps were specified throughout. Left above, a battery shown on tracer lines warming fatty acids.

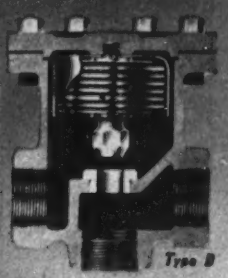
Many chemicals are made available in commercial quantities for the first time by this new Armour Chemical Division plant. With demands for process steam alone as high as 80,000 pounds per hour, the entire plant is equipped with Nicholson steam traps, both grounds and buildings.

Features of Nicholson thermostatic steam traps: 2 to 6 times average drainage capacity; shorten heat-up time. Operate at lower temperature differential; fast action keeps equipment full of live steam. Maximum air-venting capacity. Freeze-proof. Types for every process, power, heat application.

Send for NICHOLSON TRAP CATALOG 953

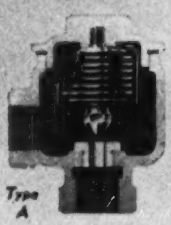
Catalog **953** contains capacity tables, installation diagrams, and data, charts and formulae for determining the proper size trap.

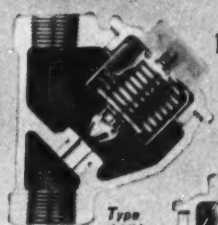


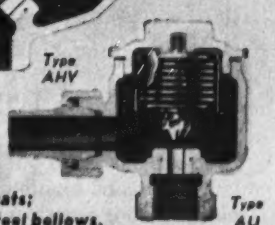


The two types above are semi-steel; sizes ½" to 2"; pressures from vacuum to 250 lbs. Type C also in cast steel for pressures to 300 lbs.

FIVE TYPES FOR EVERY PLANT USE







These three types are bronze; sizes ¼" to 1"; pressures from vacuum to 200 lbs. All 5 types have stainless steel valves and seats; bronze, monel or stainless steel bellows.

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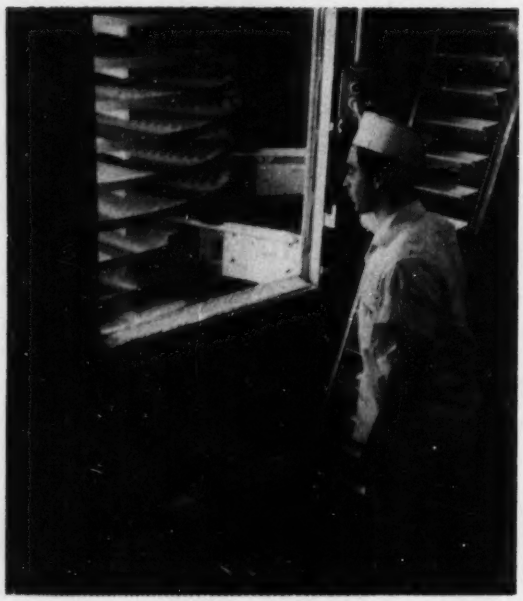
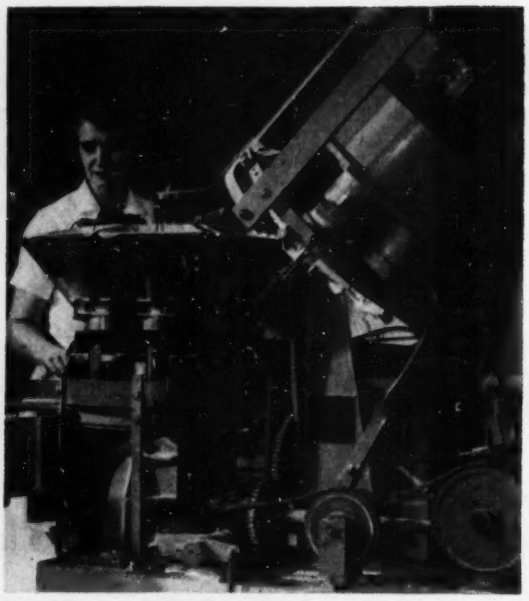
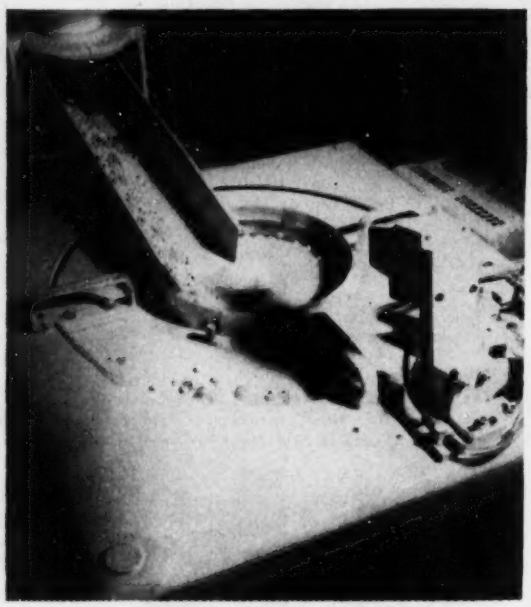
These Are the Modern Techniques Used at Warner-Chilcott



CONTINUOUS DRYING of an antacid powder.



AUTOMATIC BOTTLE filling with antacid powder.



AUTOMATIC TABLET counting with photocell.

LABORATORY CONTROL of extraction process.

Magnesium trisilicate and aluminum hydroxide are dried by Warner-Chilcott in a vertical 12-ft. high turbo-dryer; scrapers sweep powder down from shelf to shelf.

On automatic counting machines, tablets come off a tablet machine onto a spinning disk. They then cross a light beam and are counted by a photocell circuit.

In automatic bottle filling, an antacid containing sodium citrate and sodium bicarbonate feeds from a production floor above, directly into the filling machine.

In typical laboratory control, a soxhlet extraction checks on the progress of the plant fat-removing process for making thyroid extract.

Sure, that old pump still works,

but how much does it cost to keep?

That rugged old pump of yours may not be the bargain that it seems. Let's do some arithmetic. If the efficiency of the old pump is 75% vs. the 85% efficiency of the new pump, you are paying more to keep it than you would to replace it. That's because a new unit of equivalent output uses less power. Thus it soon saves its own cost — then begins to pay dividends.

Let's take a specific example—a small general service pump

Old pump efficiency 70%	28.9 BHP
New pump efficiency 79%	25.6 BHP
	3.3 BHP Saving

On the basis of 1¢ per KWH, the 3.3 BHP saving for a 6000-hour year (approximately 16 hours per day) amounts to $150. This saving, capitalized in 4 years at 4% adds up to $630. Yet the price of the new pump that saves $630 is only $438.

What would the pump replacement profit be in your particular case? Your De Laval representative can tell you exactly — in dollars and cents — as soon as he has the basic facts on your present installation. Call him in today or write to De Laval for Pump Fax Bulletin which includes a valuable "power-savings" chart.

DE LAVAL *Pumps*

DE LAVAL STEAM TURBINE COMPANY

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Soft X-Rays Measure Ultrasmall Particles

Structures either too small or too transparent to be studied with electron microscopes, such as certain viruses and protein molecules, are now being investigated by a soft x-ray method at Pomona College, Claremont, Calif. Particle sizes go to one-millionth of an inch.

The research project is headed by Dr. Burton L. Henke, designer of the special soft x-ray camera used. When a narrow beam of such radiation passes through a thin sample of material, the rays are spread into a pattern that's recorded on photographic film, measuring the size and shape of the particles.

Most significant property of soft x-rays, says Dr. Henke, is that "in contrast to conventional x-rays, they are very rapidly absorbed or scattered by matter. In fact, to these rays the very thinnest of paper is almost completely opaque."

News Briefs

Stock issue: American Cyanamid Co. has offered subscription rights to holders of its common stock for 58,235 shares of cumulative preferred stock, 3¾%, $100 par value. Until July 1, 1964, this is convertible into common stock at $50 per share of common. Proceeds from the issue will be added to the company's cash funds and will be used for general corporate purposes, including capital expenditures for new or modernized plants and research laboratories.

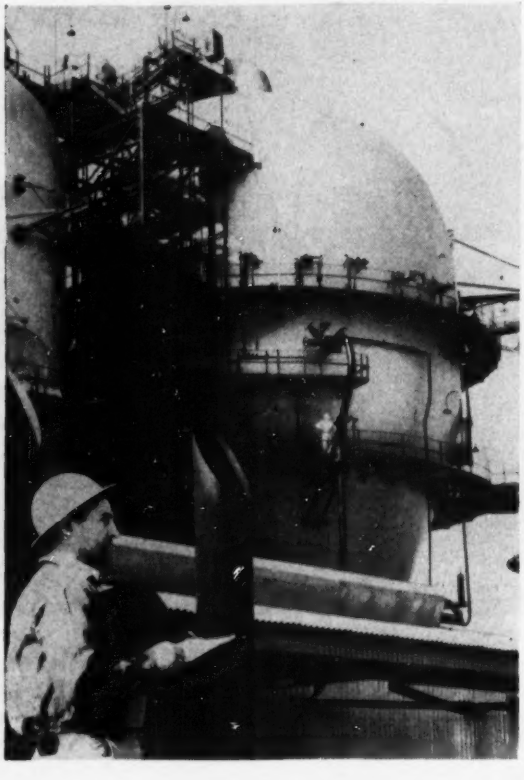
Gasoline: Licensing arrangements have been completed between Houdry Process Corp. and Sun Oil Co. for the construction of a 27,000 barrel per day Houdriflow catalytic cracking unit at Sun's Marcus Hook, Pa., refinery. Plans call for a catalyst circulation rate of 700 tons per hour; coke burning capacity of the kiln will be 16,000 lb. per hour. Catalytic Construction Co. has been awarded the building contract and completion is expected early in 1955.

Pentaerythritol: Led by Hercules Powder Co., Wilmington, Del., most major producers of PE have cut the price 2c. a lb. for the technical grade. This reflects the June 1 reduction in the price of formaldehyde. Biggest uses for PE are in the manufacture of resins, core oils, drying oils, paints and varnishes.

Pulp: The U. S. Forest Service, Juneau, Alaska, has received a request from the Alaska Pulp Co., Tokyo, Japan, for permission to buy timber from a national forest near Sitka. The company plans to build a mill to make 300 tons of pulp daily via the magnesium oxide process.

Inside at Richfield . . .

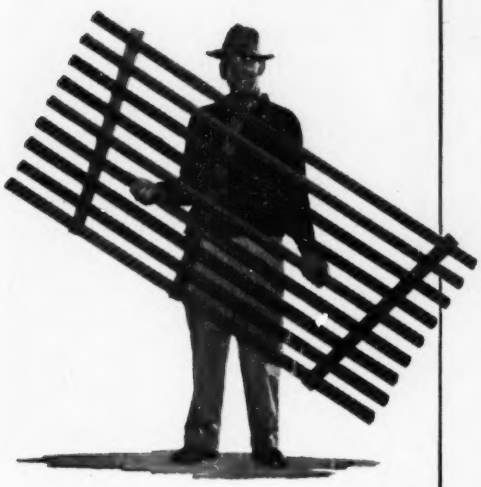
Outside at Gulf



Two Biggest Fluid Cats Start Up

Within 24 hours of each other recently, the two biggest fluid catalytic cracking units in the world went on stream. Both have nominal capacities of 63,000 barrels a day. Looking up the reactor, construction workers at Richfield Oil Corp.'s Watson, Calif., unit (*above*) had an excellent view of the giant cyclone separators used to recover finely-divided catalyst. At Gulf Oil Corp.'s Philadelphia, Pa., fluid cracker (*right*), which was built by M. W. Kellogg, man on the lower catwalk is dwarfed by the 84-ft. high catalyst regenerator behind him.

Examine the filling of a
FLUOR COOLING TOWER
and get the whole story



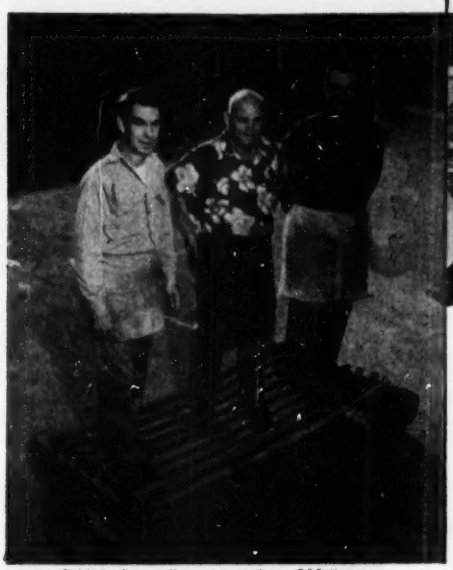
Fluor uses only 100% clear all heart redwood for filling

Fluor grid decks are not only sturdily built but are made from the highest grade redwood lumber—100% clear all heart redwood—the finest cut of the log. Clear all heart redwood is free from defects and sapwood and under normal controlled water conditions will give many many years of trouble-free service. We invite you to investigate our filling before making your selection of a cooling tower.

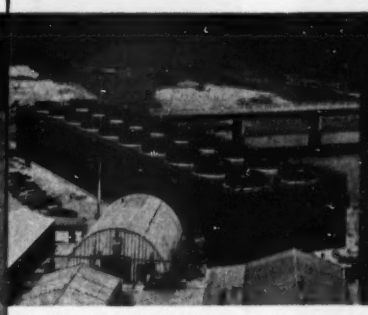
On an average, the price of a cooling tower is based 30% on the mechanical equipment and about 70% for lumber and fabrication. For example, in a Cooling Tower costing $200,000, the mechanical equipment will amount to approximately $60,000 and the tower structure about $140,000. Of this $140,000 about 30% (or $42,000) consists of the filling (grid decks) inside the tower which breaks up the water for greater exposure to air.

The filling is in reality the heart of the tower and its design and construction is of utmost importance. All Fluor Tower filling is mill cut and assembled into grid panels, 2 ft. 10" wide x 5 ft. 11½" long. Nine bars are nailed (with 6 penny copper nails) to three 1x2 cross cleats. The bars are cut on a 25% bevel from 1 x 3 boards; each bar averages 1" x 1½". Grid panels are strong enough to support three 200 lb. men and are actually used as scaffolding during tower erection and inspection. You get more years from a tower with this kind of filling.

Write for illustrated bulletin "Cooling Water for Industry."



Grid decks easily support three 200 lb. men



A 20-cell Fluor induced-draft cooling tower

A 1x3 makes two bars for Fluor grid decks

BE SURE WITH

FLUOR

THE FLUOR CORPORATION, LTD
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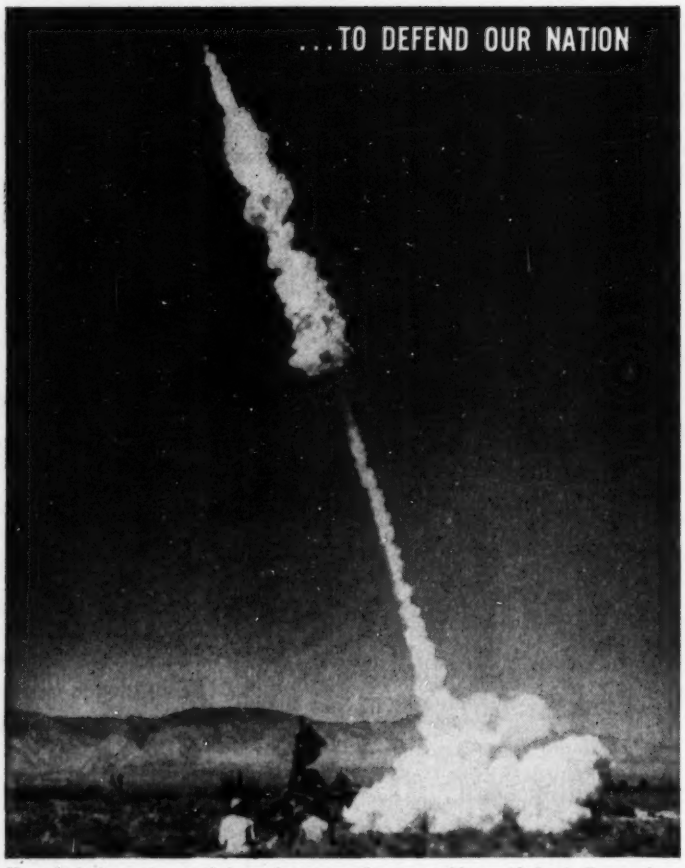
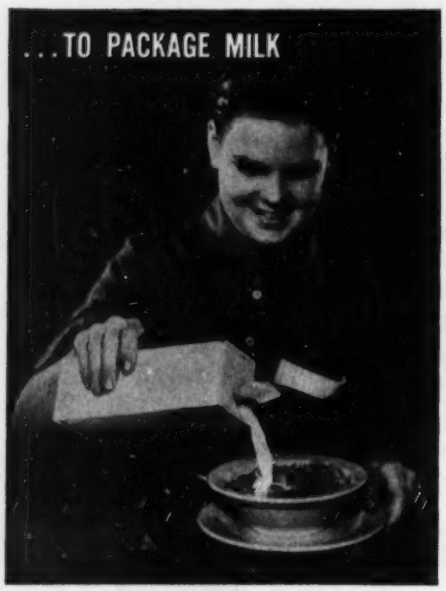
HOW HERCULES HELPS...

Most businesses are helped today by Hercules' business . . . the production of synthetic resins, cellulose products, chemical cotton, terpene chemicals, rosin and rosin derivatives, chlorinated products, and many other chemical processing materials—as well as explosives. Through close cooperative research with its customers, Hercules has helped improve the processing or performance of many industrial and consumer products. We welcome the opportunity to work with you.



Hercules' pioneering work in rocket research now enables guided missiles such as NIKE to get off the ground and quickly reach supersonic speed. This is done by means of a booster unit using a charge of solid propellant as the source of energy. This contribution to national defense stems logically from the manufacturing and technological know-how gained through many years of experience in industrial explosives.



Milk cartons represent one group of packages which Pexol® fortified size helps make leakproof during the paper-making process. Other Hercules chemical materials such as Kymene® wet-strength resin and Paracol® wax-resin emulsion are helping paper makers produce better end products.

Toxaphene insecticides control boll weevils, armyworms, and more than 170 species of insect pests that threaten the livelihood of farmers. A low-cost, extremely effective ingredient for agricultural dusts and sprays, toxaphene is the result of continuing research conducted by Hercules to solve farm problems.

HERCULES POWDER COMPANY 952 *Market St., Wilmington 99, Del.*
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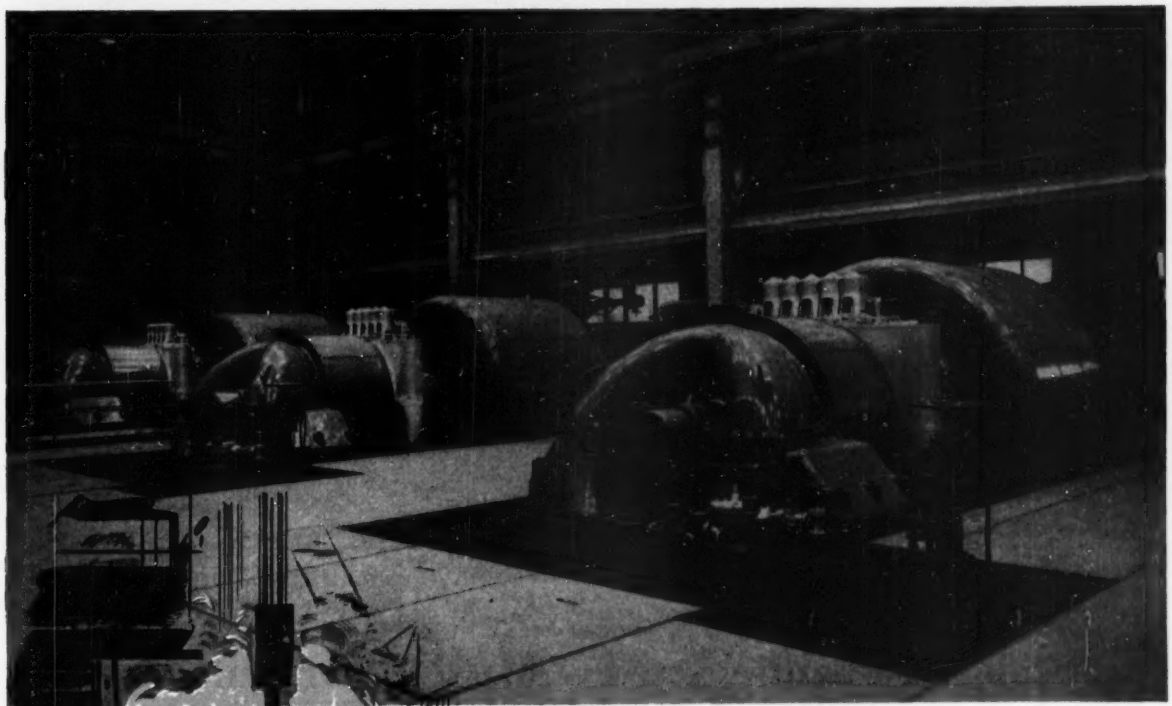
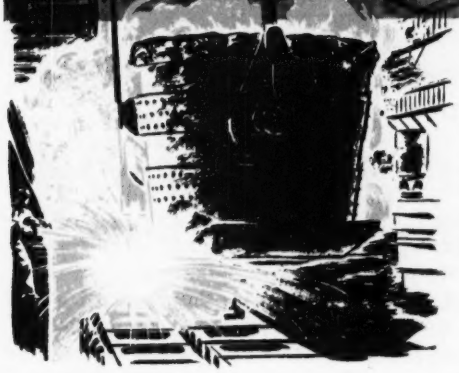
Sales Offices in Principal Cities

HERCULES

375,000 cfm for U. S. Steel's Fairless Works





United States Steel's new Fairless Works at Fairless Hills adds another 2,200,000 ingot tons to America's steel-producing capacity. Its two blast furnaces have an annual capacity of 1,134,000 tons of iron—and its nine open hearth furnaces are capable of producing 2.2 million tons of steel per year. Also, rolling facilities are provided for cold rolled sheets, hot rolled sheets, steel pipe, merchant bars and tin mill products.

Over 45,000 hp of I-R Blowers supply ALL BLAST FURNACE AIR

In the photo above, you see the three, huge blast-furnace blowers at U. S. Steel's new Fairless Works. Each of these Ingersoll-Rand five-stage centrifugal compressors supplies 125,000 cfm against 35 psig, and is driven by a 15,750 hp I-R steam turbine. They will normally operate on 850 psi steam at 900°F.

The steam boilers in the power plant are supplied by five Ingersoll-Rand 8-stage CHTB boiler-feed pumps. Fifteen I-R gas jets mix air and natural gas to provide supplementary fuel of correct BTU value.

When it comes to steel mill blowing and associated power-plant equipment, it pays to take advantage of Ingersoll-Rand's specialized experience in this field.

Ingersoll-Rand
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COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS
CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES 12-79

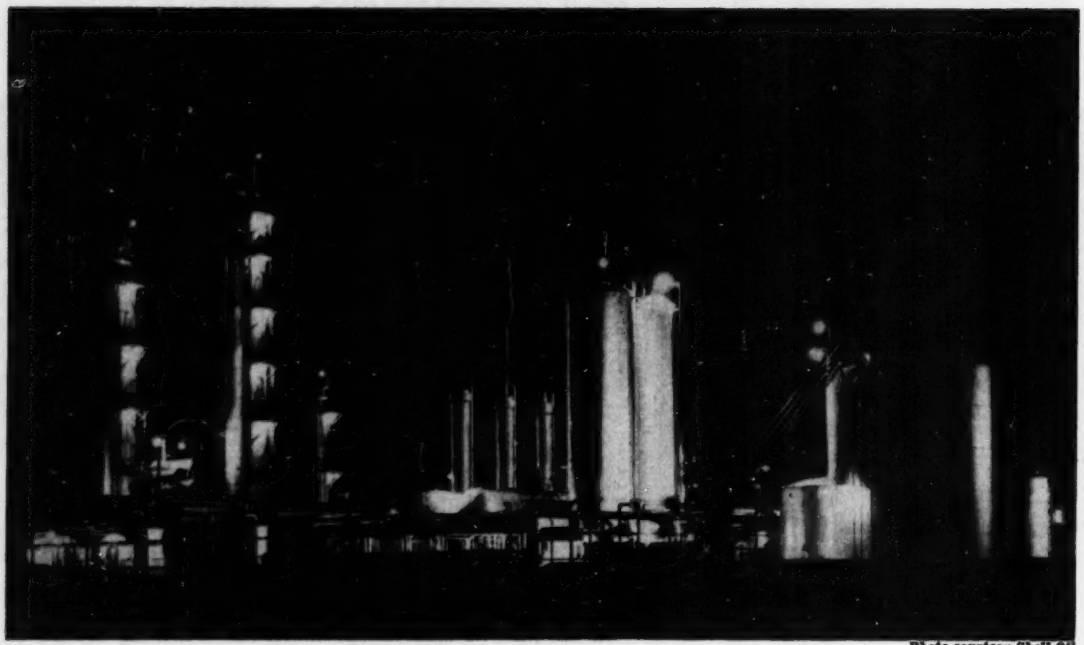


Photo courtesy Shell Oil

HIGH-BOILING fractions from alkylation unit are raw materials for . . .

Odorless Thinners: New Muscle for Oil Paint?

Oil-based interior paints, already hurt and threatened even further by latex emulsions, look to odorless mineral spirits to help stabilize their markets.

Up to about five years ago oil paint people had almost no one to vie with but each other. Then latex emulsions crashed the party, made oil paints move over and make room in the decorative interior market. Anxious to hold what they have, eager to regain part of what they've lost, some members of the solvent paint industry are taking a major step—replacing conventional petroleum spirits with odorless grades—to lick a big competitive bugaboo—oil paint's pesky smell.

Success of this readjustment rests on three conditions:

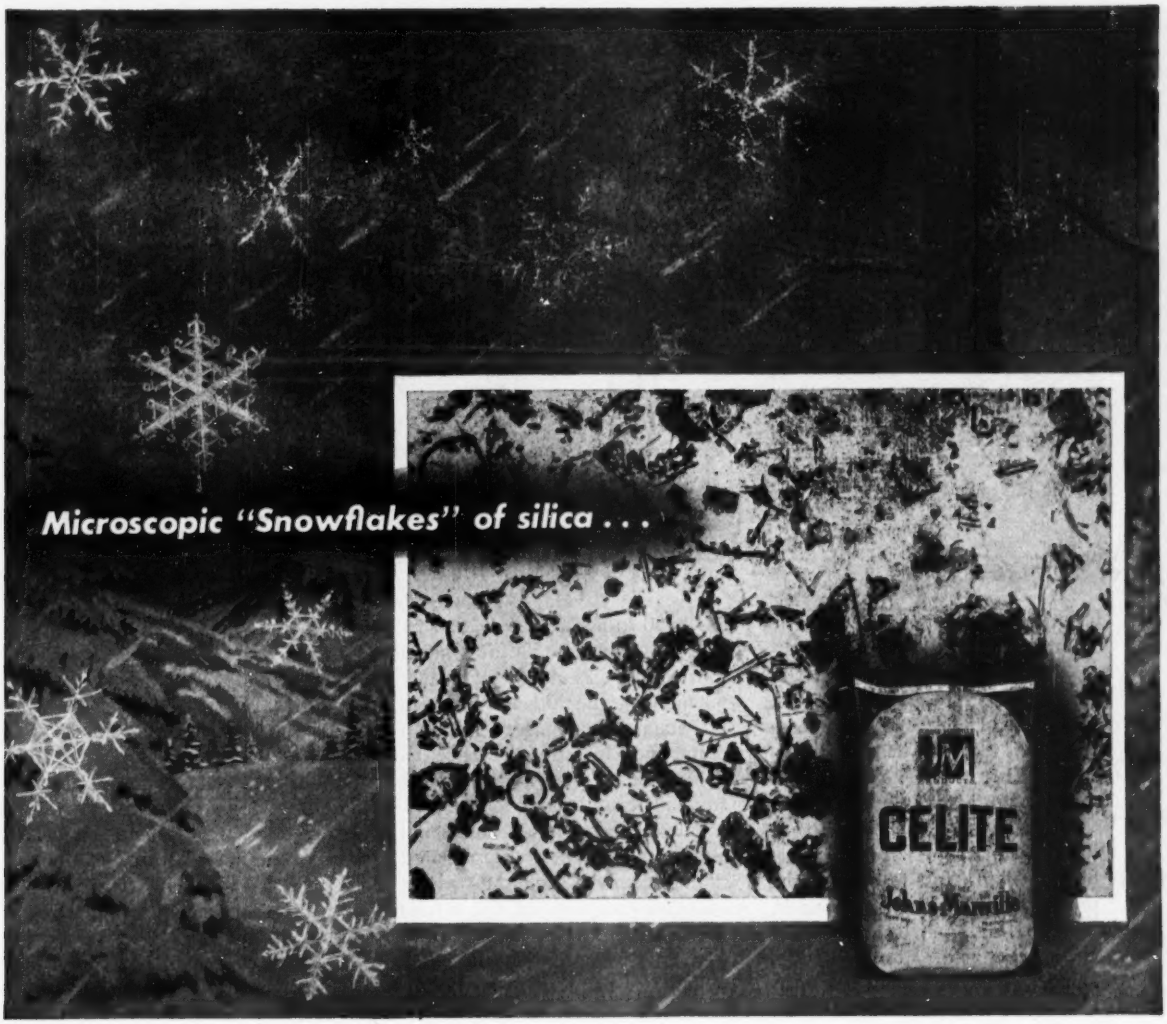
- Production of truly odorless mineral spirits—a pretty large order in a petroleum refinery, a place of many odors if there ever was one.
- Availability of alkyd resins compatible with the new thinners. Odor quality and compatibility of petroleum thinners vary inversely; increase one and you decrease the other. Conventional resins must, then, be modified to work properly with the odorless thinners.
- Winning adherents of conventional oil paint formulations over to odorless products and recapturing the fancy of those who have switched to latex.

▶**Two Steps Forward**—Majority feeling is that the first obstacle has been successfully breached. Several oil companies have overcome frustrating start-up problems and now produce a completely odorless thinner, others are very close; all could do it if they thought it really worth their while.

Opinion is more divided on the second condition, alkyd-thinner-compatibility. Some people in the oil and paint business say the problem has been pretty well licked; others say that the industry is a long way from the position where it can confidently make all oil paints with odorless thinners. Here are some solutions already offered.

Shell Oil's alkyd reduction technique prescribes addition of a small amount of glyceryl mono-oleate or equivalent to render alkyds and odorless mineral spirits more compatible. Standard Oil of Calif. claims isophthalic acid gives resins that do the required job in lesser amounts, thus can be more easily mixed with aliphatic odorless thinners. And they're planning—as is Richfield Oil—an isophthalic plant to back up this contention.

It's also safe to say that alkyd manufacturers are all working just as hard to adapt resins to the new thinners just in case. Even the



Celite's diatomite structure steps up performance

in paints—plastics—polishes . . . hundreds of other products

MICROSCOPIC PARTICLES of Celite* do a man-size job of stepping up performance for many of America's leading products. Here is how the unique structure of Celite Diatomite Powders may add more beauty, longer life, greater efficiency to *your* products, too.

For example, the spiny, irregularly shaped particles contribute surface characteristics which make them the outstanding flatting agent in paints. Again, because of their structure, Celite particles are widely used as a mild, non-scratching abrasive in finest quality auto, silver and glass polishes. Or consider molded plastics, where the strength and durability of Celite particles add life and beauty to surface finish.

Moreover, Celite particles in mass have great bulk per unit weight, so they are invaluable for extending, dispersing or fluffing up dry powders. They have high absorptive capacity, too, so they keep powders free-flowing, they serve as a medium for shipping or storing liquids in a dry form.

Which of the many Celite advantages can you use to build product performance or cut production costs? A Johns-Manville Celite Engineer will gladly discuss your problem, without obligation. For his services or more information, simply write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

*Celite is Johns-Manville's registered Trade Mark for its diatomaceous silica products.

JOHNS-MANVILLE JM PRODUCTS **Johns-Manville CELITE** INDUSTRY'S MOST VERSATILE MINERAL FILLER

Products on these pages this month made news . . .

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Odorless Paint Thinners	142A	Silicones for leather	148C
p-Tert-butylbenzoic acid	144A	Polyester films	148D
Paper size	146A	Foam fire extinguisher	150A
Three aids in plastic reinforcing	146B	Low density silica gel	150B
Dielectric coating	146C	Benzoate plasticizer	150C
Soluble riboflavin	146D	Defoamer for paint industry	150D
Crude vanillin	148A	High molecular weight bisphenol	150E
Silicones for wool	148B	Benzoic acid-glycol esters	150F

. . . For more about any item, use Reader Service postcard (p. 427)

skeptics will admit success is only a matter of time although they suspect that resultant cost will be more than much of the market will bear.

▶ **Haves and Have Nots**—But controversy is really rife regarding market development. The oil companies line up this way:

The Haves (they market odorless as well as conventional spirits): Shell, Phillips (first to develop the product), Socony-Vacuum, Sinclair, Standard of Calif. (most recent entry), Richfield and Atlantic Refining. The Have-Nots (they market only conventional and low odor spirits or none at all): Esso, Texaco, Standard of N. J., Standard of Ind. (reported leaning toward an odorless product), Gulf and Sun Oil, among others.

▶ **Pro**—The Haves strongly believe odorless thinners are here to stay or at least feel they can't afford not to have such a product. They're of the opinion that paint formulations have been successfully adapted to incorporate the new thinners and will find increasing acceptance in the interior market despite the extra cost imposed by odorless mineral spirits.*

▶ **Con**—The Have Nots are less intrigued, feel that investments of $500,000 to $1,000,000 in new facilities to obtain odorless mineral spirits are not justified by market potential, would just as soon keep iso-paraffins funneling to premium motor fuel. Investment cost seems to depend on how much existent equipment can be used for the jobs.

These petroleum companies point to difficulties in shipping and storing odorless products without contamination; in obtaining a fully odorless paint even with odorless spirits available as a ingredient; in selling the paint maker and consumer on the worth of paying a higher price. A "low" odor product will give, some say, sufficient compatibility with resins together with relief from "painty" smell, to prove most economical in the long run. Extreme pessimists take a dim view of oil paints—odorless or otherwise—and their long range chances against latex paints.

Actually some petroleum outfits —particularly the giants—have little or no interest in mineral spirits, are so absorbed in gasoline as to regard paint solvents as distinctly minor in importance to them.

▶ **There Is a Trend**—Nevertheless, odorless mineral spirits are making headway; estimates of current sales run from 15 to 35 million gallons yearly. Alkyd paint makers are shifting to odorless formulations more or less rapidly although there's no evidence yet of latex moving back.

But let's try to narrow that sales spread down. Using, as a basis, a sales figure for paints, varnishes and lacquers of $1.4 billion, we judge about 350 million gal. of paint were sold in 1953. Decorative paints' share was 200 million gallons, of which about 150 million went to interior jobs. Subtracting estimates for all water-based paints from this last figure leaves 110 million gallons of interior oil paint, requiring 50 million gallons of thinner. We estimate this, then, to be the maximum possible market for odorless oil thinners (excluding the domain of water paints) last year and consider 15 million to be a reasonable figure for actual present day activity.

There's a suspicion in the ranks of the interested oil companies that promotional publicity, comparable to the high-powered kind heralding latex paints, will push odorless spirits' sales a good deal further. They reason that a public, made fully aware that odorless oil paint is a reality, will insist on using it in homes, hospitals, hotels, etc.

The paint maker is taking no chances, though. He's keeping one hand in oil paints—conventional, low odor and odorless—but he's got the other one in latex emulsions.

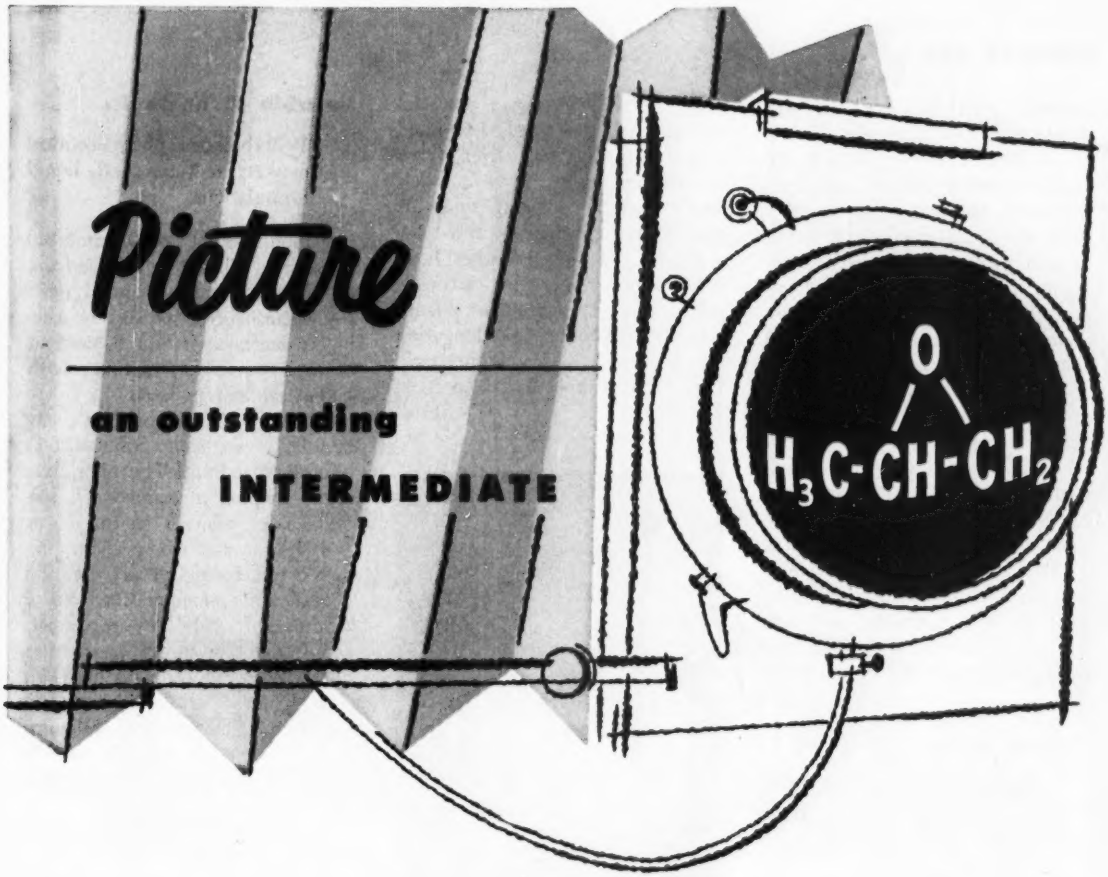
142A

* Odorless thinner raw materials come from alkylate bottoms, boiling between 350 and 400 F., and are high grade materials suitable for direct inclusion in automotive gasoline. As such they have a premium value over conventional mineral spirits even before necessary refining steps—redistillation, treatment, possible addition of inhibitors—have been taken. A selling price of at least 1½ times ordinary spirits is unavoidable.

p-Tert-Butylbenzoic

New chemical intermediate is commercially available.

Made commercially by blowing air through hot liquid p-tert-butyltoluene in the presence of a metallic



CARBIDE'S PROPYLENE OXIDE

To meet the increasing industrial need for this excellent intermediate, CARBIDE has expanded its production of propylene oxide. Since it reacts with all compounds having an unstable hydrogen atom, a variety of applications are possible.

Two of the uses are in the production of petroleum de-emulsifiers and textile lubricants. Propylene oxide is also an effective stabilizer in the formulation of products from resins that contain chlorine.

Your CARBIDE technical representative is ready to discuss these and other applications of propylene oxide. A Technical Information Sheet on propylene oxide is available from the CARBIDE office nearest you; ask for F-8485. In Canada: Carbide Chemicals Sales Company, Division of Union Carbide Canada Limited, Toronto.

* * *

An added highlight of CARBIDE'S propylene oxide expansion is the increased availability of propylene oxide polymers. Such polymers as UCON fluids and polypropylene glycols 150, 425, 1025, and 2025 are excellent lubricants and also may be used in hydraulic fluids. For additional information on propylene oxide polymers, ask for the booklets, "UCON Fluids and Lubricants" (F-8326) and "Polypropylene Glycols" (F-7220).

"Ucon" is a registered trade-mark of Union Carbide and Carbon Corporation.

CARBIDE AND CARBON CHEMICALS

Carbide and Carbon Chemicals Company
A Division of
Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.

catalyst, p-tert-butylbenzoic acid should find wider uses now.

• Present uses: p-TBBA upgrades vegetable oils, by partial replacement of fatty components of short and medium oil alkyd resins, to give paint vehicles with faster drying time, harder surface, improved color and color retention, higher gloss and better soap and chemical resistance.

• Potential uses: Preparation of alcohol and glycol esters for plasticizing polyvinyl chloride, cellulose ethers and esters; manufacture of insecticides, waxes and corrosion inhibitors for metals; as soap components (metal salts of p-TBBA) of greases, thickening agents for hydrocarbons and paints, and stabilizers for vinyl polymers and copolymers.–**Shell Chemical Corp., New York, N. Y.** **144A**

Paper Size

Combines efficiency with low foaming, gives dollar savings of 30% over rosin size.

Optimum fortification with highest efficiency is claimed for Mersize RM Dry in sizing papers.

Mill trials indicate sharp reductions are possible in the amount of size needed compared with rosin size, with resultant dollar savings of about 30% without loss of sizing test. On sheet requiring two per cent rosin size a saving of one dollar a ton can be realized.

Mersize RM Dry may be added directly to the beater in dry form, or as a water solution, and does not require modification of mill practice or equipment.–**Monsanto Chemical Co., St. Louis, Mo.** **146A**

Aid Plastic Reinforcing

Three plastic agents simplify construction and strengthen structure of plastic car bodies.

• Vibrin VPA, a water soluble material, prevents plastic body sticking to mold. Its blue color helps spray operator check uniformity of release coating as it goes on and insures its complete removal later by water washing.

• Vibrin Shellcoating, a polyester surface coating, is applied to mold atop release agent, covers glass reinforcing fibres, gives a slick finish that takes paint smoothly and has resistance to impact.

• Vibrin 151 is a polyester body resin which thoroughly saturates glass fibre reinforcement, lends sufficient flexibility–5% elongation –to take road shock without cracking.–**U. S. Rubber Co., New York 20, N. Y.** **146B**

Dielectric Coating

Silicone rubber helps electric and electronic components run cooler.

Fully cured coatings of Silastic S-2007 have twice the thermal conductivity of conventional resinous or rubber dielectrics, assuring cooler operation at high temperatures. And transformers enclosed with this silicone rubber (see cut) pass both moisture and low temperature flexibility requirements of MIL-T-27 grade 1.

S-2007's protective jackets are formed without pressure or graduated curing, are heat-stable, oxidation-resistant and have a hardness in the range of 40 durometer, Shore A scale.–**Dow Corning Corp., Midland, Mich.** **146C**

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Soluble Riboflavin

Will broaden pharmaceutical market for Vitamin B_2 liquid formulations.

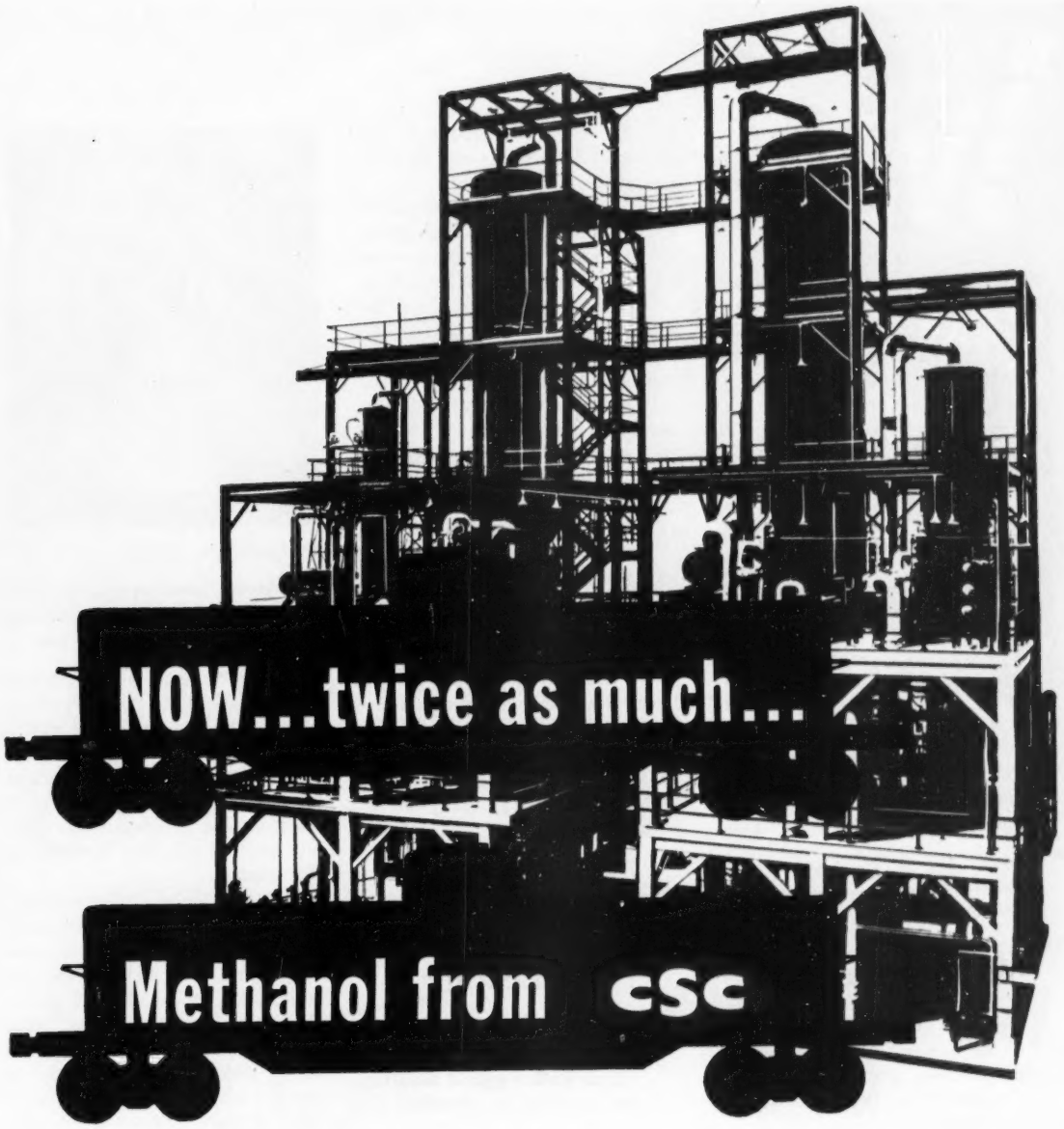
Announcement of commercial production of a highly soluble form of riboflavin comes as good news to pharmaceutical processors seeking to increase vitamin B_2 content of their liquid formulations, both parenteral and oral.

Clues to the new product's success lie in its name: riboflavin-5′-phosphate sodium. The phosphate ester grouping increases water solubility; its position at the 5′ or end spot in the ribose chain preserves full biological activity. To obtain this configuration on a commercial scale requires great care, especially in the separation of the specific product from its isomers–some of which have reduced biological potency–and elimination of metallic impurities which would precipitate insoluble riboflavin phosphate ester salts.

Use of riboflavin in parenteral solutions (for hypodermic injections), water dispersible multivitamin drops, elixirs and soluble tablets has been hampered because of its very low solubility (0.12 mg. per ml.) and intensely bitter taste. Two roads around the solubility impasse have been tried: use of solubilizers and development of a metastable form of riboflavin which dissolves rapidly to give high supersaturations. Neither has been a complete answer to the problem.

Even large amounts of solubilizers–which frequently cost more than the riboflavin, itself–have not obtained concentrations of B_2 greater than 2-3 mg. per ml. Supersaturated solutions of metastable ribo have unpredictable stability–its final solubility will be the same as that of ordinary ribo.

Riboflavin-5′-phosphate sodium, on the other hand, easily forms, without solubilizers, stable solutions of 20-30 mg. per ml. (riboflavin equivalent) with much improved taste. To the parenteral producer this means high blood levels of B_2 are now obtainable for the first time. To the oral formulator this means higher con-



Giant, new production facilities are now in full operation at our Sterlington Plant in Louisiana. Basic in methanol for a number of years, CSC can now supply twice as much as it formerly did.

Pioneer in high-pressure synthesis, CSC is ready to serve all American Industry with high-quality synthetic methanol, minimum purity 99.85%, in tank cars, tank trucks, barges, tankers, drums.

Bulk distribution has been expanded to give fast delivery to the Midwest and eastern seaboard. Tank and barge service points have been enlarged and increased in number. Bulk terminal facilities are now maintained at Carteret, N. J., Camden, N. J., New Haven, Conn., New Orleans, La., Chicago, Ill.

COMMERCIAL SOLVENTS

260 MADISON AVENUE NEW YORK, N.Y.

CSC INDUSTRIAL CHEMICALS

centrations of ribo with less trouble and cost as well as better taste.

Present price of 5′-phosphate—$140 a kilo or $200 a kilo on a straight riboflavin basis—is considerably higher than for USP riboflavin ($100 a kilo) or its metastable form ($130 a kilo). The extra premium is expected, however, to be more than offset in parenteral and oral preparations by the advantages of high, unaided solubility; savings in expensive solubilizers and easier formulation.—**Hoffmann-La Roche Inc., Nutley, N. J. 146D**

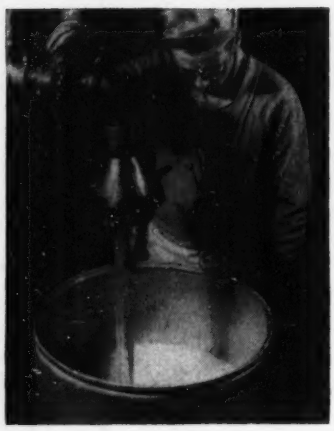
Crude Vanillin

Available in tonnage quantities as an economical chemical intermediate.

Lioxin, a 97% vanillin compound made from sulfite lignin, offers the chemical industry a raw material which can be used in many applications more economically than pure vanillin. And although Lioxin cannot be substituted for vanillin as a flavor—its odor and taste are distinctly different—it may be used as an odor masking agent.

Vanillin, being both an aromatic phenol and aldehyde, has many useful applications. Here are some where a cheaper and less pure form of vanillin like Lioxin might be substituted:

- Vanillin serves as a brightener in zinc plating baths.
- Syntans for tanning have been made from vanillin.
- Ammonium polysulfide reacts with vanillin to form dithiovanillic acid whose zinc salt is a vulcanization inhibitor.
- Oxidation of linseed oil is strongly accelerated by chemical vanillin.
- Vanillin prevents foaming in lube oils.
- Methoxyhydroquinone, produced by alkaline hydrogen peroxide oxidation of vanillin, shows antioxidant properties and is useful as a photographic developer.—**Ontario Paper Co., Ltd., Thorold, Ontario. 148A**



Polyester Film

Mylar, possessor of outstanding mechanical and dielectric properties, finds more uses.

First introduced more than two years ago, Du Pont's polyester film, Mylar, has been evaluated extensively and found to give design improvements and cost reductions in many applications. A new $10 million plant will begin this summer to meet expected demand for the product.

Here are Mylar's talking points:

Chemical inertness: Resistance at room temperature and even near the boiling point to such solvents as benzene, xylene, hexane, naphtha, ethyl acetate, carbon tetrachloride, methanol and glacial acetic acid. Mylar also stands up to most oils, greases and commonly used electrical varnishes. Phenols, cresols and severe hydrolysis degrade its physical properties.

Tensile strength: 23,500 psi.—two to three times that of cellophane and acetate film.

Impact strength: twice that of any other known commercial film.

Tear strength: less than polyethylene but greater than cellophane and acetate.

Flex strength: cellulosics fail after a few hundred flexings; Mylar endures 20,000 flexes.

Dimensional stability: Retains all its mechanical properties over the temperature range, −20 to 80 C.

Dielectric strength: greater than nearly all other insulators. ¼ mil Mylar stands up to 7,500 v. per

Silicones for Wool

Dow Corning's treatment lends more oil and water repellency, gives old fibre new muscle in battle with synthetics.

Dow Corning 105 Emulsion, a silicone finish, has been successfully applied to wool without sacrifice to its natural advantages, will help it compete more successfully with synthetic fibers. The most oil resistant silicone ever developed, 105 Emulsion approaches the ideal requirements of a finish that repels grease and oil as well as water.

105 Emulsion cures at a temperature wool can stand—10 to 20 min. at temperatures as low as 250 F.—to impart wrinkle resistance, preserve tensile strength and increase flex abrasion resistance 30-65%.—**Dow Corning Corp., Midland, Mich. 148B**

. . . and Leather

General Electric's Dri-Film can be applied at the tannery; guards leather against moisture yet preserves its character.

A new Dri-Film silicone water repellent protects leather against water yet permits it to breathe and flex properly. And leather so processed retains its weatherproofing through laundering and dry cleaning. Stitched leather garments will not rip at the seams because of shrinkage.

Silicone treatment is expected, also, to afford durable protection to suedes and grains and kid skins.

Process techniques have been developed which permit Dri-Film repellent to be applied industrially by the tannery.—**General Electric, Chemical Division, Pittsfield, Mass. 148C**

New! ADDITIONS to the SOLVAY LINE

Chloroform
Carbon Tetrachloride
Methyl Chloride
Methylene Chloride

Backed by Over 73 Years of Experience Making Quality Chemicals for Industry!

Since 1881, SOLVAY's reputation for quality and service has helped make it the largest producer of alkalies in the world.

And with the start of chloromethane production at SOLVAY's new plant at Moundsville, W. Va., chemical buyers can look forward to the same consistent purity and dependability in these new products that has been the SOLVAY tradition for over seven decades.

We will be glad to supply samples and technical information on these new products. Inquiries are now invited for prices on both carload and less carload quantities.

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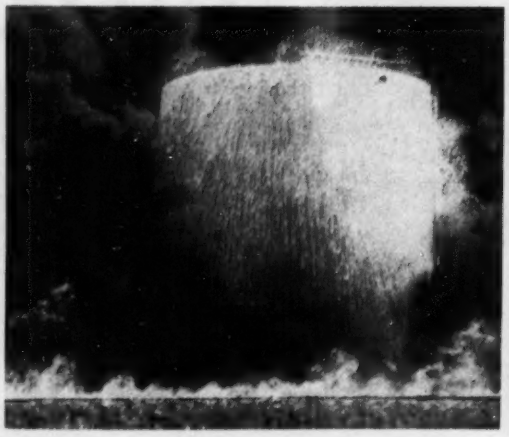
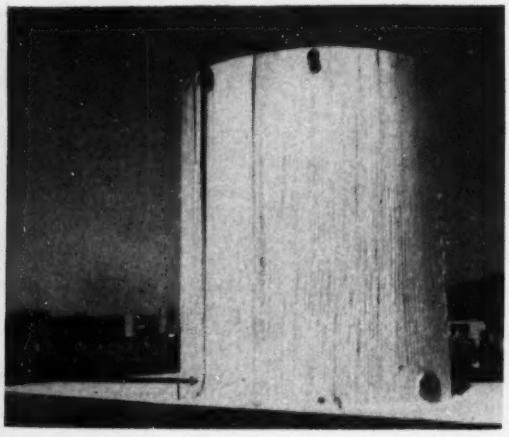




Aerated Foam Douses Flames in Record Time

A new foam extinguisher, Unox, gave a solid performance in recent firefighting tests when 660 gal. of kerosene, set afire in a 2,500 sq. ft. diked area around a water tank, blazed furiously. At a signal, Unox foam—a 1-2% water solution of Tergitol wetting agents whipped to a dense foam—began to pour over the top and down the sides of the fire-beset tank. In 7½ min. the tank looked like a frosted wedding cake and the fire was out. Extinguisher used: 26 gal. of Unox concentrate in a total volume of 1,600 gal.—Carbide and Carbon Chemicals Co., New York 17, N. Y. 150A

mil; 2 mil Mylar handles 4,500 v. per mil at 25 C. and 60 cycles.

Insulation resistance: Second only to polystyrene among commonly used dielectrics but possesses a higher softening point. Mylar's resistance at 140 C. is two decades greater than that of plastic impregnated paper.

These properties suggest Mylar's use as a moisture proof, chemically inert lining for drums used to ship corrosive chemicals (see cut); a tough, dimensionally stable base for industrial and electrical tapes; a component in many types of electrical insulation.—**E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. 148D**

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Product Briefs

Low density silica gel—4.5 lb. per cu. ft.—becomes transparent when mixed in vehicles, remains in suspension indefinitely in most organic solvents. Syloid 244 is extremely fine—particles are 1-2 microns—and highly oil absorptive—240 lb. per 100 lb. of silicon dioxide.—**Davison Chemical Corp., Baltimore 3, Md. 150B**

Benzoate plasticizer Flexol 77-G is available now in tank car quantities. It's compatible with polyvinyl chloride, acetate and butyral; ethyl cellulose; polystyrene; acrylates; cellulose acetate butyrate. Price: 32¢ per lb.—**Carbide and Carbon, New York 17, N. Y. 150C**

A foam-reducing, surface active agent being used extensively in rubber and resin paint manufacture is Polyethylene Glycol 400 Monolaurate S-307. This product is a good pigment wetting agent, paint leveler and emulsifier yet does not cause excessive foaming.—**Glyco Products Co., Inc., Brooklyn, N. Y. 150D**

A cashew bisphenol, cardolite 6463, having a molecular weight (410) nearly twice that of the usual bisphenol, shows to advantage as an epoxy resin intermediate. Only half as much epichlorhydrin is needed and, once cured, the resins have greater flexibility. —**Irvington Varnish Insulator, Irvington 11, N. J. 150E**

Benzoic acid esters of diethylene glycol (Benzoflex 2-45) and dipropylene glycol (Benzoflex 9-88) —first commercial low-freezing plasticizer of its type—are available. As primary plasticizers for vinyl chloride resins, they lower processing time and temperature. —**Tennessee Products and Chemical Corp., Nashville, Tenn. 150F**

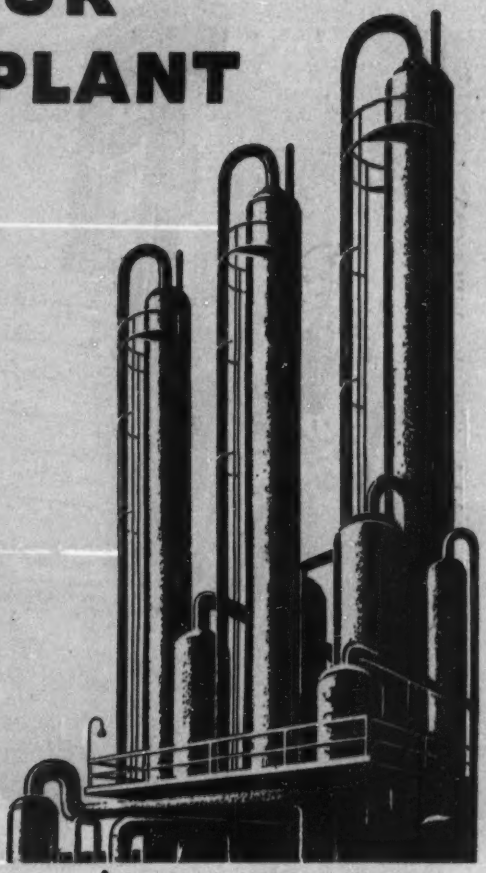
Klingerise

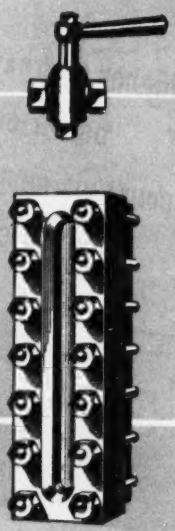
YOUR PLANT

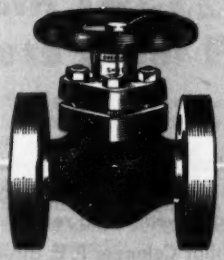
COCKS

GAGES

VALVES







INSTALL Klinger FITTINGS

Write for the Klinger Master Catalog which describes the complete range of Klinger products, corrugated asbestos sheet packings for all purposes, valves, cocks, level gages, synthetic and silicone rubbers.

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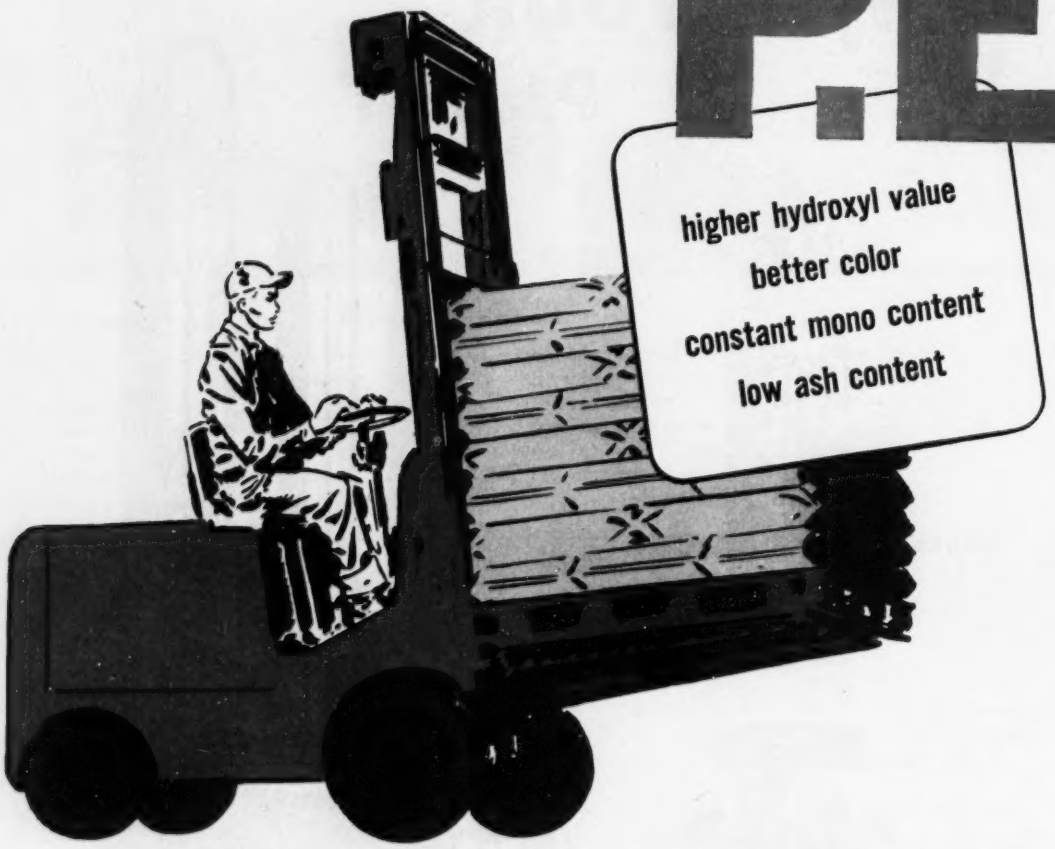
When you buy pentaerythritol

make the advantage *Decisive*

. . . specify Celanese* P.E.



Manufacturers know the advantages of pentaerythritol in alkyd resin production: more rapid bodying . . . superior gloss and gloss retention . . . greater hardness . . . water, alkali and weathering resistance.

Now, many are finding that Celanese P.E. assures them a new high level of purity and uniformity—the result of a continuous production process using Celanese Formaldehyde and Acetaldehyde. They're discovering ingredient savings through its higher hydroxyl value. Its lower color rating saves on white pigment. The problems of filtering and frothing during cooking are minimized.

These manufacturers are benefiting from the handling efficiency of palletized unit-ton shipments . . . the convenience of bulk stocks warehoused in Newark (N. J.), San Francisco, Chicago, Los Angeles and Oakland . . . as well as the extra economy of mixed carloads of Celanese P.E., Paraformaldehyde, and Glycols.

The Alkyd Resin Group of the Celanese Technical Service and Application Laboratories is prepared to assist you in making complete formulations, tests and cost analyses.

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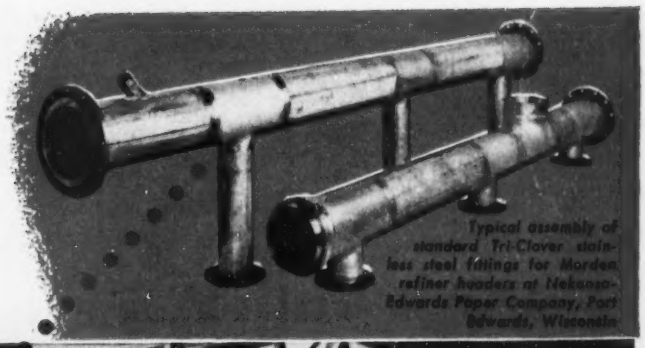
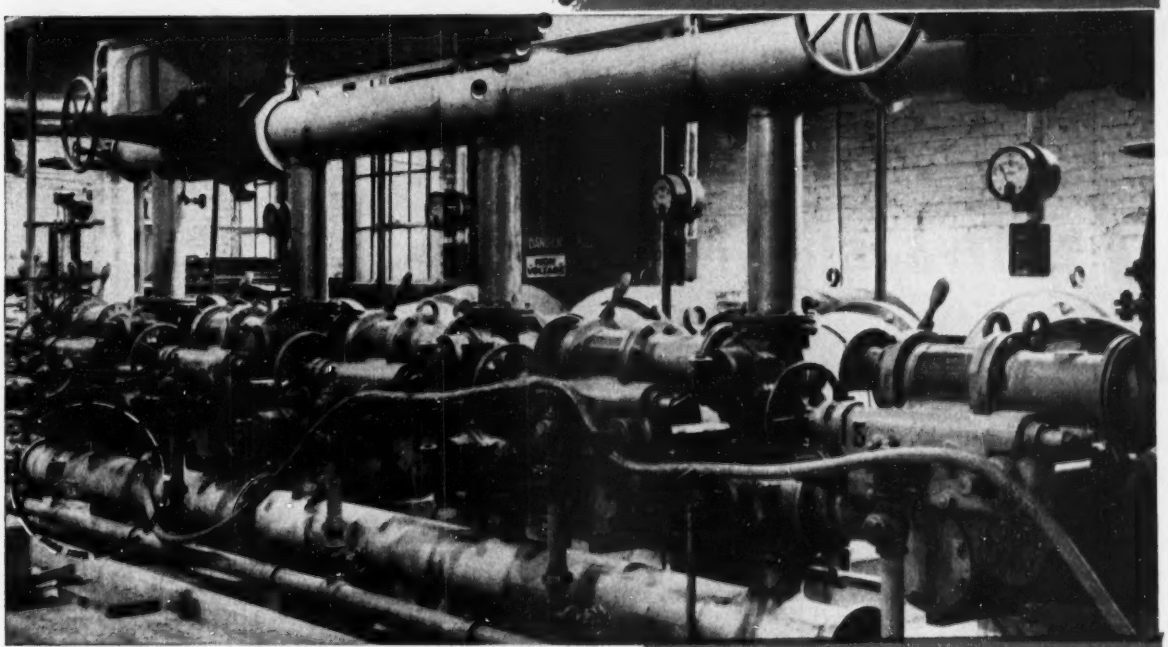
Save Time and Money on Corrosion-Resistant Line Assemblies . . .



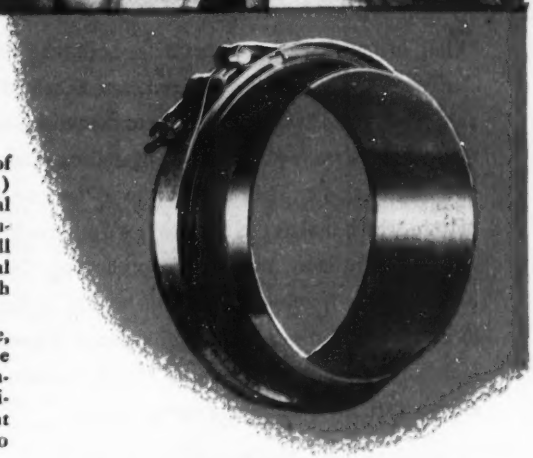
Typical assembly of standard Tri-Clover stainless steel fittings for Morden refiner headers at Nekoosa-Edwards Paper Company, Port Edwards, Wisconsin



. . . with TRI-CLOVER Stainless Steel Fittings

Among the most important factors governing the selection of corrosion-resistant fittings, piping and line assemblies are: (1) The assurance of *full* corrosion-resistance in the actual material *and* in the finished assemblies; (2) The assurance that the manufacturer has had ample experience and ability in producing a full range of corrosion-resistant material; and (3) assurance that actual costs for installation will be as low as possible, commensurate with the quality of the finished assemblies.

When you specify *TRI-CLOVER* stainless steel fittings, pipe, tubing and pumps you can be *sure* that all of the above factors have been met . . . And you can be *sure* that you are getting *full* corrosion-resistance in *every* fitting and fitting assembly . . . thanks to Tri-Clover's specialized experience in solving corrosion-resistant piping problems for chemical-process industries from coast to coast.



STAINLESS STEEL CLAMP-TYPE CONICAL FITTINGS . . . requires only two simple ferrules and clamp to assure leak-tight joints thru the use of Teflon gaskets. Fast, simple assembly and disassembly—Just one of the complete range of Tri-Clover Stainless Steel fitting types to meet practically every corrosion-resistant piping requirement.

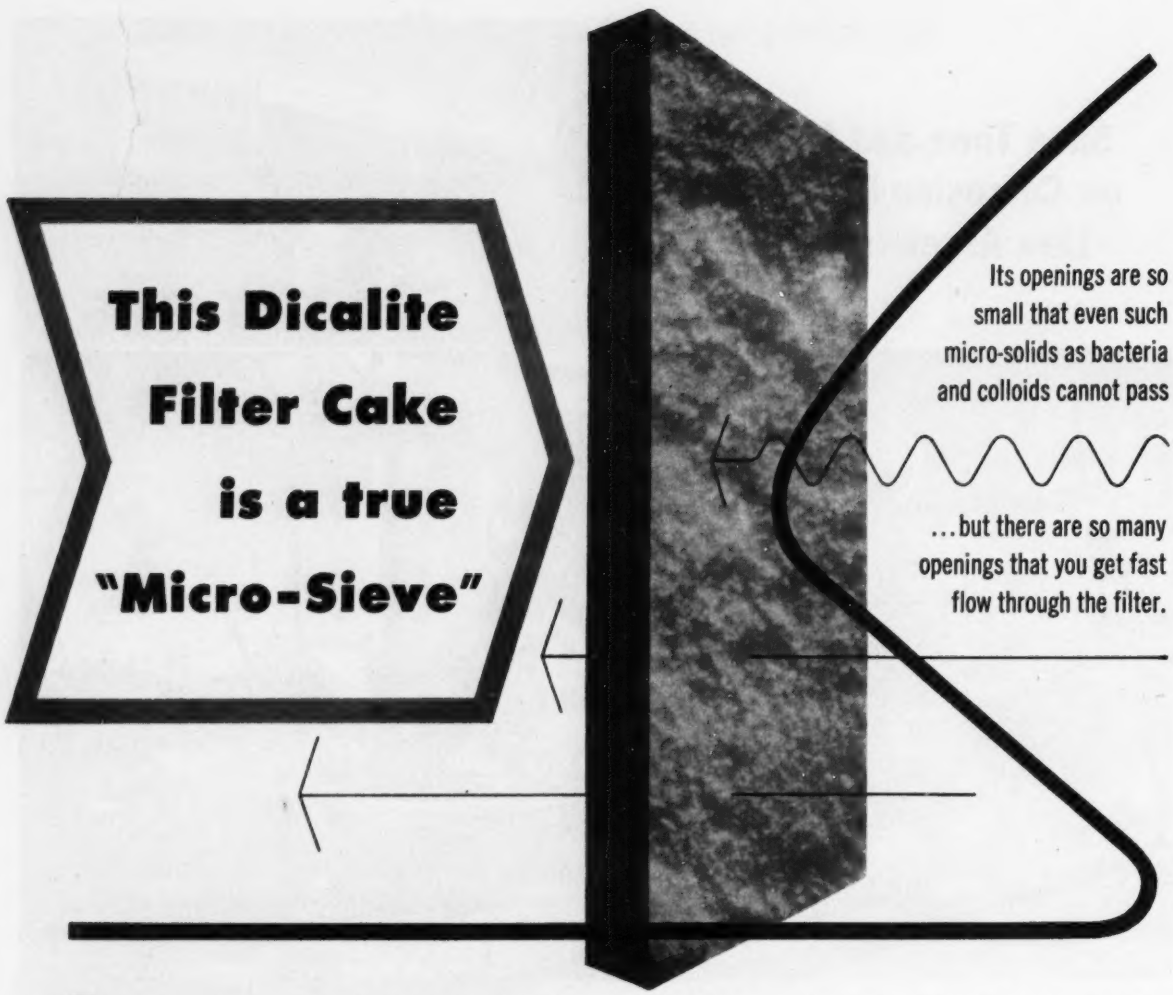
LADISH CO.
Tri-Clover Division
KENOSHA WISCONSIN

THE Complete LINE

See your nearest TRI-CLOVER DISTRIBUTOR
EXPORT DEPARTMENT, 8 So. Michigan Ave., Chicago 3, U.S.A.

I 354

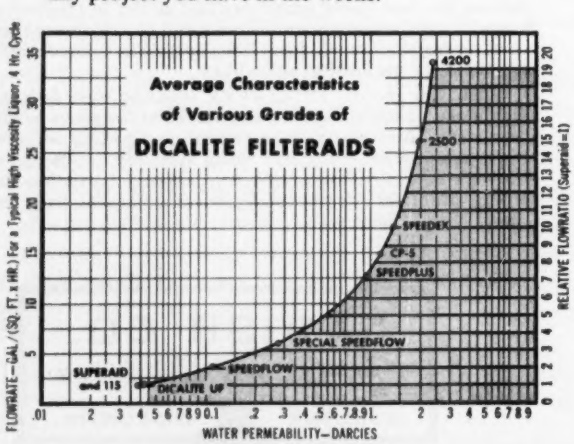
This Dicalite Filter Cake is a true "Micro-Sieve"


Its openings are so small that even such micro-solids as bacteria and colloids cannot pass
...but there are so many openings that you get fast flow through the filter.

That, in a nutshell, is the reason for both the brilliant clarity and high production achieved with Dicalite filter-aids. This efficiency is directly due to the unique structure of the diatom particles—elongated or otherwise irregular in shape. They build up in a "lattice-work" pattern which makes the filter cake a "micro-screen."

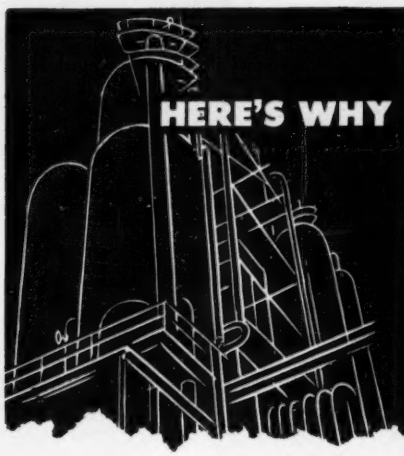
Chemically inert, sterilized in processing, Dicalite is suitable for filtering all types of liquids from acids to zein. It is used in processing hundreds of products including antibiotics, beverages, foods, metals, oils, sugars, varnishes, wines and many others.

And you can depend on Dicalite quality. Starting with the country's finest crude diatomite, all Dicalite materials are processed under a rigid system of continuous control. Write for Bulletin B-12—or a Dicalite Engineer will be glad to call and discuss a problem or any project you have in the works.



Dependable GREAT LAKES **Dicalite**® DIATOMACEOUS MATERIALS

DICALITE DIVISION • GREAT LAKES CARBON CORPORATION, 614 SO. FLOWER STREET, LOS ANGELES 17, CALIFORNIA

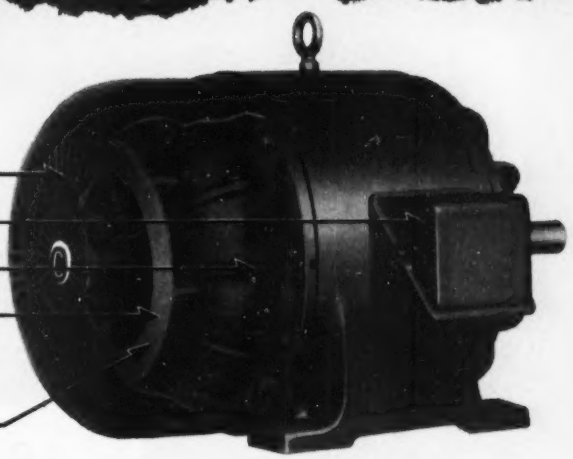


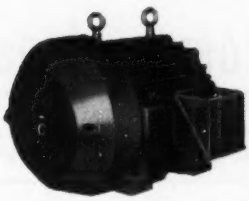
HERE'S WHY

Century P R CHEMICAL MOTORS

These Performance Rated features resist chemical corrosion

- Cast-iron fan guard
- Cast-iron terminal box
- Cast-iron frame and end brackets
- Either bronze or aluminum fan available to you
- Fan constructed to operate in either direction of rotation





Rib type construction available with or without steel covering shroud in sizes 50 to 100 H.P. Steel fan guard.

Dual frame type available in 3 to 40 H.P. sizes

"Air-over-motor" type in 1-1½-2 H.P. sizes. Steel frame.

Performance-Rated Century MOTORS

1/8 to 400 H.P.

Performance Rated motors are offered by CENTURY to match the motor to the job. The lowest cost motor is the properly applied motor. The wide range of sizes and other features in Century's Performance Rated line means you get Century motors application engineered to match whatever equipment you want to drive.

Mail this coupon to find out how Century Performance Rated motors can help you on your current project.

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G-E Cabinetrol* Panels Are Custom-engineered for Your Exact Specifications

1. **STANDARD COMPONENTS** assure fastest possible production and delivery of your panels. Modern factory techniques speed completion of your order.
2. **YOUR REQUIREMENTS** are followed exactly. Thorough examination and testing assure "job-tailored" performance.
3. **EXPERIENCED G-E ENGINEERS**—working closely with you—design the unit to meet your application.

Cabinetrol panels are not costly, improvised modifications of some other type of control center. These panels form a **standard** low-voltage control system which handles all motor types up to 600 hp from a central location. You get the time-saving and money-saving advantages of standard components which are custom-assembled.

For complete information, contact your nearest G-E Apparatus Sales representative. Or write for the descriptive bulletin, GEA-3856. Section 780-4, General Electric Company, Schenectady 5, New York.

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GENERAL ELECTRIC

Tube Selection Cannot be Reduced to a Formula

—even a complicated one

Selection of the proper grade of stainless steel for a particular application is a relatively complex problem and involves manufacturing, metallurgical, chemical and economic considerations. Although it is complex it has been made easier by industrial research. Data accumulated through years of research and experience gained in helping to solve varied application problems are now available to guide the user in the solution of his present problems.

It is practically impossible to list all the media in which stainless steels will resist corrosion. It is even more difficult to enumerate all the conditions under which the stainless steels will resist effectively the corrosive effects of such media. Frequently, a relatively minor contaminant, when combined with the main reagent, will cause a more detrimental corrosive action than the latter by itself. This is particularly true of iron salts which, in the presence of chlorides, often prove to be a very potent corrodent, producing pitting.

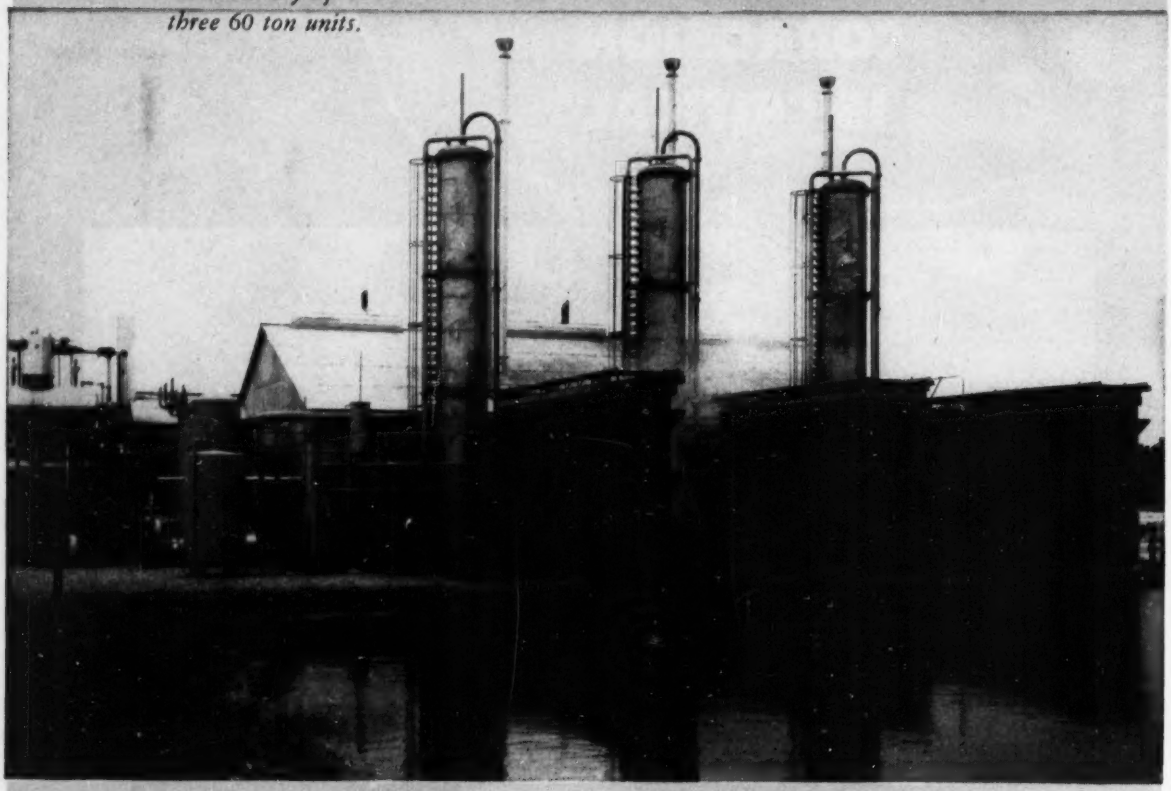
It is always advisable to test a sample under actual operating conditions, especially before extensive untried installations are made. Proper tube selection starts with expert opinion, available to you through Mr. Tubes, your nearby B&W Tube Representative. There is no substitute for the kind of experience with pressure tubing problems you'll find at B&W. Ask Mr. Tubes for help in matching tubes to jobs.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

B&W SEAMLESS and WELDED TUBES

TA-4061(P)

Built for Commercial Solvents Corporation, this C & I Ammonia Oxidation Plant has a battery of three 60 ton units.



What's new in nitric acid?

Here's one of the latest additions to an already impressive string of nitric acid plants designed and constructed by C & I. It's Commercial Solvents' new 180-ton-per-day installation at Sterlington, La. Nitric acid will be used to make solid ammonium nitrate by C.S.C.'s single step Stengel process.

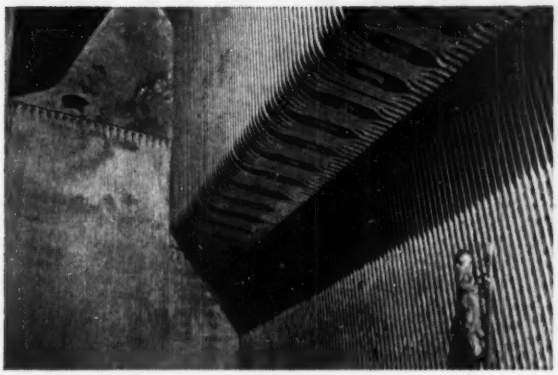
In recent years, 90% of America's nitric acid plants have been designed, engineered and erected by C & I. Due to vast experience in this field, C & I is able to deliver these plants at a fixed cost on a fixed date with performance and production guaranteed. C & I is also prepared to furnish the newest type Ammonium Nitrate Solutions and Solids Plants and Complex Fertilizer Plants on this same basis.

Specialists in C&I *Processing Ammonia*

THE CHEMICAL & INDUSTRIAL CORP.

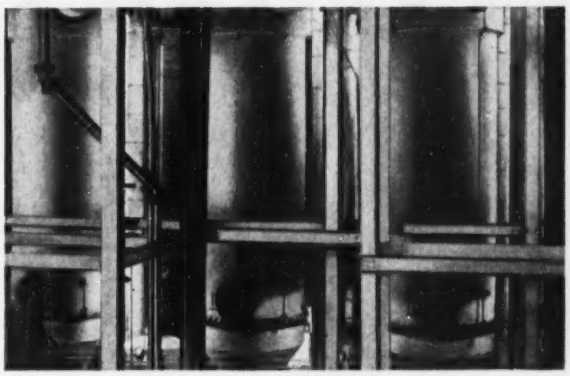
CINCINNATI 26, OHIO

There's no limit to what you can do with the right tubing!



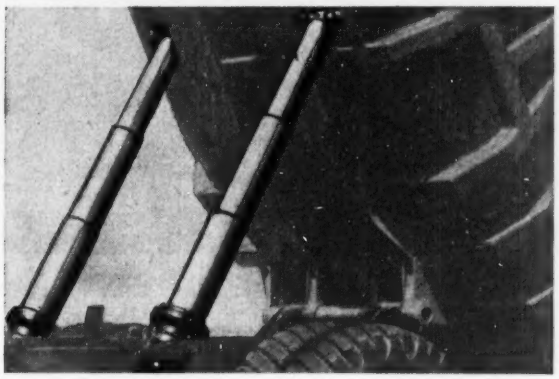
make power to light a city . . .

There are more than 12 miles of Globe seamless pressure tubing (carbon, alloy, and stainless) in this modern boiler which is a vital part of the electric power plant that serves a large metropolitan community.



transfer corrosive liquids . . .

Black liquor, used in production of kraft papers, is highly corrosive and has to be carried under pressure in multiple effect evaporators. Gloweld (electric welded) Stainless Steel Tubing was found to do the job best—at lowest cost.



or lift a load of dirt . . .

Mounted on a dump truck, these twin hydraulic hoists are built to handle heavy loads. Design and production is simplified by making the telescoping arms of Globe mechanical tubing.

THERE are probably a thousand and one different tube applications that could be made in your own products or industry. Check the possibilities. Globe engineers will be pleased to give helpful advice on how the right tubing — Globe tubing — can help you save time, save money, save manpower. Write for literature on any of these products.

GLOBE STEEL TUBES

GLOBE STEEL TUBES CO.
MILWAUKEE 46, WISCONSIN

Field Offices: Chicago • Cleveland • Detroit • New York
Philadelphia • St. Louis • Denver • Houston
San Francisco • Glendale, Calif.

A quick check list of GLOBE STEEL TUBES

ALLOY STEEL: to meet heat, corrosion, pressure, and structural strength problems. Carbon Moly, Chrome Moly Nickel and others. Sizes: O.D. from ½ to 6 inches. Wall thickness .035 to 1.000 inch.

CARBON STEEL: for load bearing structural members with strength, least weight . . . for fast, low-cost manufacturing of machine parts or pressure tubing applications. Low and medium carbon. Sizes: O.D. ½ to 7½ inches. Wall thickness: .028 to 1.000 inch.

STAINLESS SEAMLESS: in sizes from ½ inch to 6 inches O.D., and in pipe sizes ⅛ inch to 6 inches, standard, extra strong and double extra strong weights.

STAINLESS WELDED: Gloweld electric welded stainless steel tubing offers many economies. Sizes: O.D. ¼ to 5 inches. In standard wt. pipe sizes ⅛ to 2 inches. In lightweight pipe sizes ⅛ to 4½ inches inclusive.

HIGH PURITY IRON: Globeiron tubing is 99.5% pure ingot iron. For applications where ductility, toughness, easy weldability and easy forming are desired or for use where magnetic permeability and electrical properties are required.

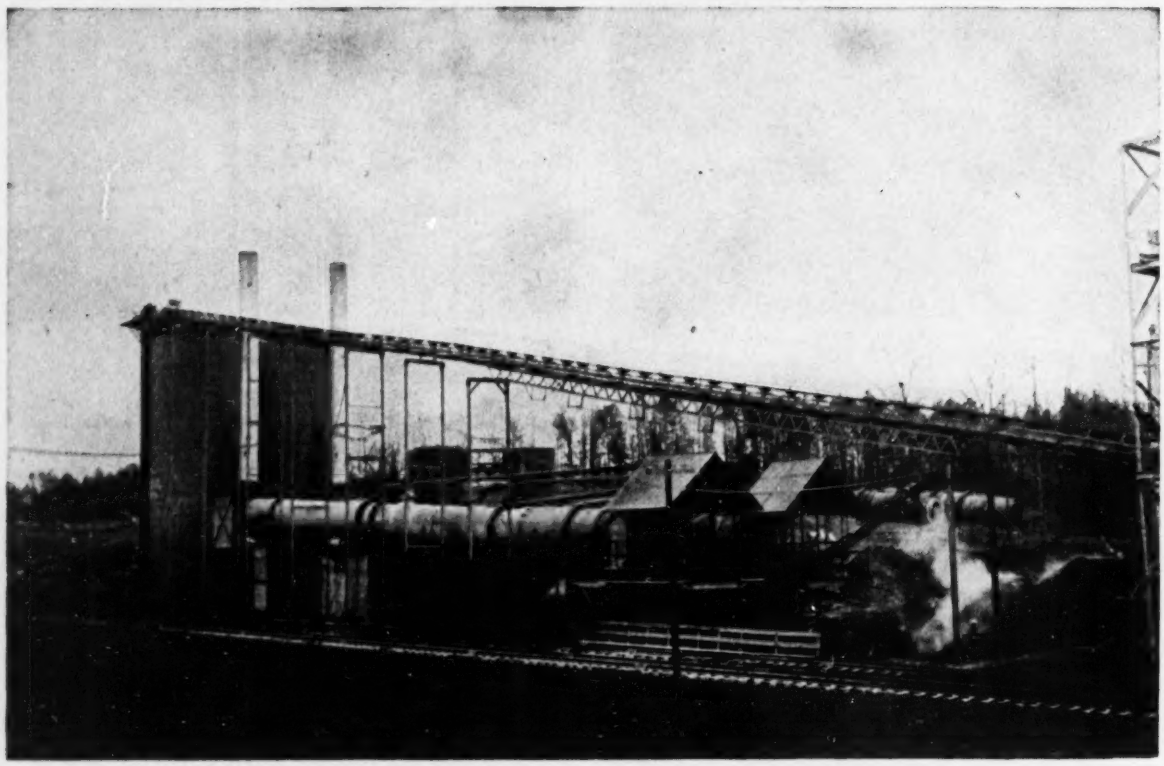
SPECIAL ANALYSES: Globe Steel Tubes Co. regularly produces tubing to special customer specifications. Consult with Globe's representatives for analyses to suit your needs.

GLOBE WELDING FITTINGS: seamless, carbon and stainless, available in a complete line of sizes and weights through Globe distributors in key cities.

YOU GET MORE VALUE

...more years of productive life

with VULCAN ROTARY KILNS



Here is one of the newest lightweight aggregate plants in the Southeastern section of the United States. It is the Carolina Solite Corporation, near Aquadale, North Carolina, a subsidiary of the Southern Lightweight Aggregate Corp.

The above illustration shows two rebuilt VULCAN rotary kilns, 7x8x135', fired with powdered coal, and producing "Solite" controlled lightweight aggregate. The finished "Solite" is a tough, hard manufactured lightweight aggregate identical in characteristics to that produced by the parent companies' Bremo Bluff operation.

The Aquadale operation is another instance of the successful re-use of VULCAN rotary kilns, in the lightweight aggregate field, where the Vulcan Iron Works had no record of Carolina Solite Corporation owning Vulcan kilns. It is a good example of the ruggedness of VULCAN equipment, since these kilns had already served a very useful and normal length of life in another industry before going into lightweight aggregate.

If you and your Company have any questions regarding Rotary Kilns for any application, The Vulcan Iron Works, with their 105 years of experience, will be there on short notice to assist you in every way possible. Why not write today for their 28-page Rotary Kiln Bulletin A-442.

Any information on items listed below will be sent to you immediately:

- Rotary Kilns, Coolers and Dryers
- Rotary Retorts, Calciners, Etc.
- Improved Vertical Lime Kilns
- Automatic Quick-Lime Hydrators
- Briquetting Equipment
- Open-Hearth Steel Castings
- Heavy Duty Electric Hoists
- Self-Contained Electric Hoists
- Cast-Steel Sheaves and Gears
- Diesel Locomotives
- Electric Locomotives and Larrys
- Steel Plate Fabrications
- Hydraulic Presses

VULCAN IRON WORKS

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ESTABLISHED 1849

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ATLAS POWDER COMPANY, CANADA, LTD., BRANTFORD, CANADA

COUNTER-CURRENT USE OF DARCO SAVES CARBON IN PURIFICATION PROCESS . . .

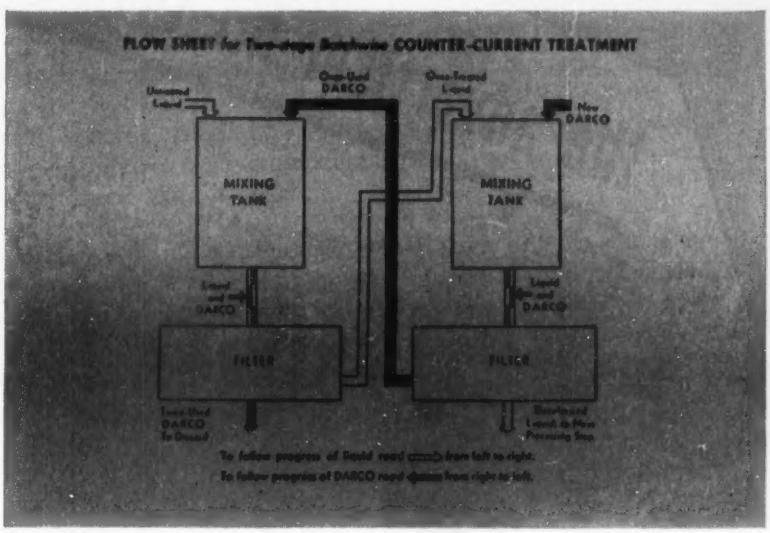
If you have been using, or are planning to use Darco activated carbon for purification of a solution, it will pay you to investigate the economics of various methods of treatment. From the standpoint of carbon consumption, the counter-current technique generally gets the most "mileage" out of carbon . . . often saving as much as 40 per cent in comparison to simple, one-shot treatment.

This method, perfected by Darco technicians, uses the same carbon twice . . . and performs treatment in two steps. The untreated liquid is first partially purified with Darco that has already been used once. The final purification step uses new Darco. It can be seen that as the liquid moves from the first to the second treatment stage, Darco moves in the opposite direction . . . hence the counter-current name.

This method is efficient because it divides the adsorption into two parts. The more difficult part (the removal of the last portion of impurity) is given to the new carbon. The easier part (the removal of the first portion of impurity) does not require new carbon and can be done by partially spent carbon.

The lower dosage of carbon that this method makes possible not only cuts carbon costs but also reduces the amount of liquid lost in the filter cake. This is an important consideration when treating costly liquids.

For a discussion of the techniques and equipment requirements, send for our booklet, "Handbook of Counter-Current Treatment with Activated Carbon."



Dye sealer solutions kept clean with Darco

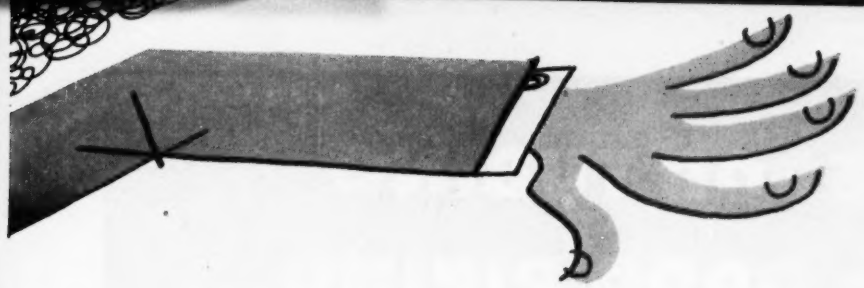
The use of Darco activated carbon for purification proves useful not only in the treatment of products but also of solutions used in processing. A typical example of the latter class of applications is the way Darco helps to keep dye sealer baths in good condition.

These solutions are used in a dyeing process where products are immersed in the color-bearing material in one tank, then transferred to a sealer solution which "sets" the dye. As various colored dyes are used, the sealer solution soon collects a number of different hues carried over by the products.

The more murky it gets, the greater is the probability that carried-over dyes will contaminate the products, and that the color values of finished goods will vary from the desired uniformity.

The cure for this ailment was simple. The sealer solution is circulated through granular Darco, which effectively takes out the undesirable dyes that accumulate in the tank. The sealer stays in top condition . . . and at exceptionally economical cost.

more engineering-minded production men read it . . . more



Wow! You'd have thought we'd run all the ads upside down, judging from advertisers' reactions when CHEMICAL ENGINEERING switched to a new arrangement for ads and editorial pages this year. They calmed down soon enough though . . . when they found out how you readers had asked for the new format and how pleased you were with the results.

one

Your comments were responsible, you know. From letters and surveys, we learned your preferences . . . found you liked the wide representation of top suppliers in the ads, the practical "how-to" approach in reading matter. Getting a physical layout to satisfy everybody was a little tougher. But when we discovered how so many readers clipped CE articles yet wanted to keep the rest of the issue intact, we knew tightening up editorial make-up was the answer.

Guess a lot of our advertisers hadn't thought much about these points. Many of them didn't know about the research that guides CE's editors. Few realized we're constantly probing and testing preferences on format and reading material, were amazed to learn we'd been surveying 1000 subscribers every month. Liked the idea fine, once they found out you readers sparked the changes.

Fact is, most everybody likes the new make-up now. The concentration of full editorial pages lets you find your favorite departments faster, they're easier to read and you can file selected material without destroying the rest of the book. Editors and layout men approve it, advertisers are happier, your comments have been gratifying. What more could we ask?

Only this . . . any time you've got a criticism, an opinion or a new idea to make CE better, just tell us about it. We'll encourage your suggestions and, whenever possible, try to incorporate them in your business paper. After all, you're the guy we're trying to satisfy. And there's nothing we like more than to know you're getting your money's worth . . . in CHEMICAL ENGINEERING.

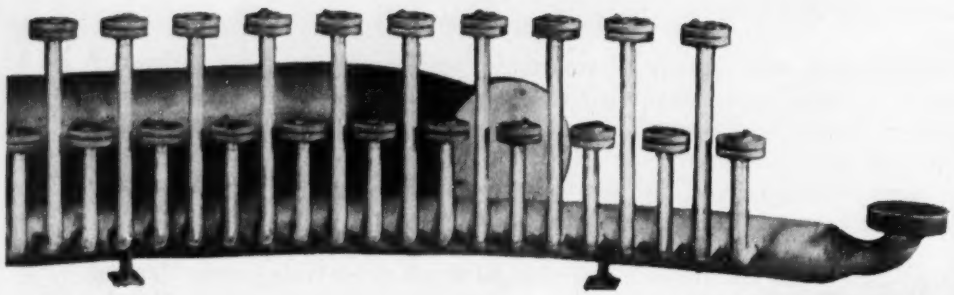
chemical engineers profit from it . . .

Chemical Engineering

ABP ABC

A McGRAW-HILL PUBLICATION, 330 WEST 42ND STREET, NEW YORK 36, N. Y.

It Takes GOOD TUBING *To Make* GOOD PIPING...



and WELDCO *Makes Only the Best!*

The stainless steel piping, shown in the photo above, required the best tubing available. WELDCO was chosen for this important job because it met the rigid specifications of the buyer. It was selected, also, because of its excellent fabricating qualities . . . easy to bend, form, weld and assemble.

WELDCO is lightweight and corrosion-resistant . . . has a smooth inside finish, exceptional strength, and complete uniformity throughout. It's available in Stainless Steel, Monel, Hastelloy, Inconel, Nickel, and Cupro-Nickel, in tube and pipe sizes from 3" to 30", Schedules 5 and 10, and 3" to 12", Schedule 40.

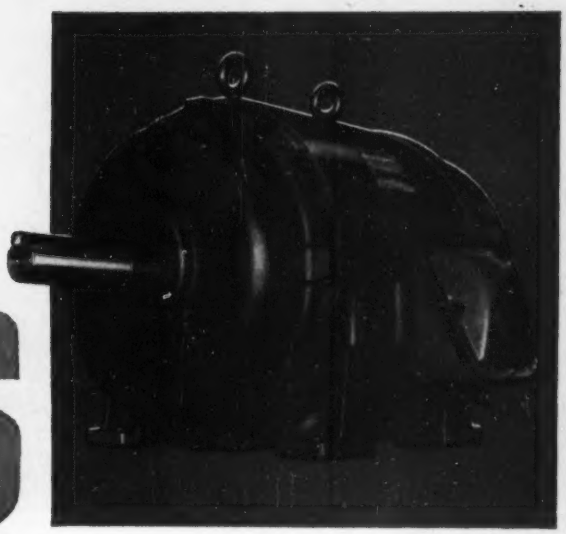
Whenever you need dependable tubing for special problems — or for regular applications — specify WELDCO, your best buy in top-quality tubing.

Whatever Your Needs In Tubing . . . . You're 'Way Ahead With WELDCO

THE YOUNGSTOWN WELDING & ENGINEERING CO.

3721 OAKWOOD AVE. . . YOUNGSTOWN, OHIO

"ALL MOTORS ARE NOT ALIKE!"



FOR CHEMICAL SERVICE, Reliance Motors are built better to last longer. These *Precision-Built* Motors combine maximum strength with tough, chemical-resistant Reli-X insulation and corrosion-resistant frame and bearing brackets. Write for Bulletin B-2101.

RELIANCE *Precision-Built* MOTORS

B-1470-B

RELIANCE ELECTRIC AND ENGINEERING CO.

1063 Ivanhoe Road, Cleveland 10, Ohio • ***Sales Representatives in Principal Cities***

Starting point for quality products

Quality products begin with quality ingredients. That's why Nialk Chemicals are used today in so many exacting applications.

for example...

NIALK TRICHLORethylene: For fast, low-cost degreasing of metal parts, NIALK TRICHLORethylene is enjoying a rapidly growing acceptance. This superior degreasing agent cleans and dries in record time...is nonflammable...can be heated by either gas, steam or electricity...and is completely re-usable after distillation.

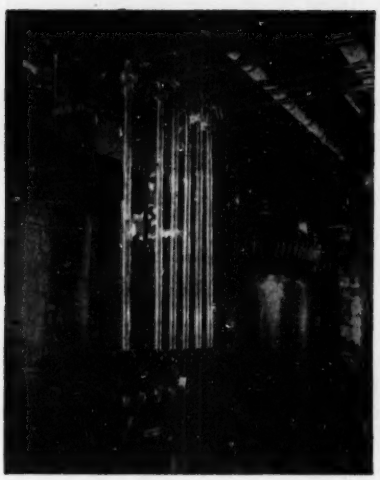
It is dependable performance like this that has earned for all NIALK chemicals the confidence of many American industries.

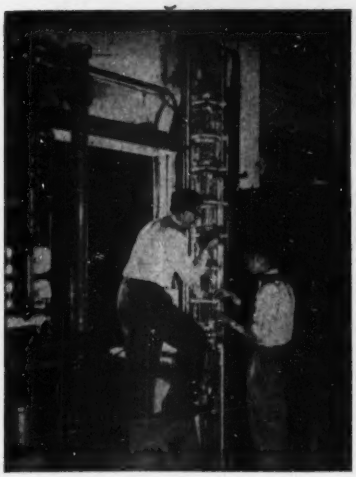
NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, New York

Nialk

LIQUID CHLORINE
CAUSTIC POTASH
CARBONATE OF POTASH
PARADICHLOROBENZENE
CAUSTIC SODA
TRICHLORethylene
(TETRACHLORO PHTHALIC ANHYDRIDE)





Far Left: **PYREX brand "Double-Tough" Glass Pipe** ends replacement of corroded lines... simplifies cleaning . . . enables you to *see* what's happening inside the line.

Available in 1″ to 6″ I. D. with all standard fittings, as well as sink traps. Your plant personnel can handle PYREX pipe without special training.

For information and pictures, check the coupon below for "PYREX brand Glass Pipe in the Process Industries" (EA-1) and "PYREX brand 'Double-Tough' Glass Pipe and Fittings" (EA-3).

Left: **PYREX brand Fractionating Columns** give you unusual advantages in solving fractionating and absorption problems. No corrosion, no contamination. And you *see* flow, performance and condition of product.

Available in 4″ and 6″ sizes with any number of plates.

Standard packed columns are available in 4″, 6″, 12″ and 18″ inside diameter sizes. Can be packed with PYREX brand Glass Rachig Rings. Check the coupon for data sheet of helpful information and applications.

Have YOU a corrosion problem one of these glass products can cure?

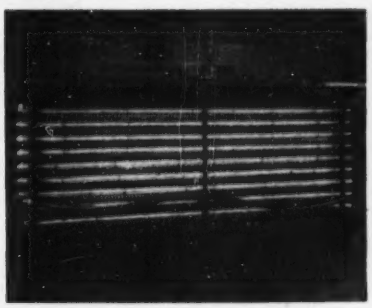
Corrosive liquids create special problems. Your pipes, coolers, and fractionating columns forever need attention, repairs or replacement. Product contamination is common. There's no fast, sure method of cleaning corroded equipment.

Why put up with these headaches when you can easily avoid them with PYREX brand glass equipment?

These are reasons why glass takes the headaches out of corrosive liquids:

1. *Glass does not rust* . . . It's unaffected by all *acidic* solutions and acids except hydrofluoric.
2. *Glass is non-contaminating* . . . The high chemical stability of PYREX brand glass equipment assures product purity.
3. *Glass is transparent* . . . You see what's happening as it happens. You have an immediate visual check on conditions within the equipment.
4. *Glass is easy to clean* . . . There's no place for deposits to build up on its hard, smooth surface.
5. *Glass is strong* . . . PYREX brand glass No. 7740, used for pipe, cascade coolers, and towers, has great physical and thermal shock resistance.
6. *Glass is economical* . . . Installation is simple. Maintenance is negligible. You will find the initial and maintenance costs of PYREX equipment low.

It will cost you nothing to find out if PYREX brand glass equipment can help you. And finding out may bring important savings. *Write, wire, or phone the nearest Corning plant equipment distributor listed below. Or mail the coupon.*



Above: **PYREX brand Cascade Coolers** give you low cost per BTU transferred, *plus* low cost operation. As many as 40 tubes can be stacked vertically in a single unit (20 tubes under one trough) to meet varied requirements. You can use cheap river or sea water as the coolant.

Check illustrated bulletin (PE-8) on the coupon for complete information on PYREX brand Cascade Coolers. It demonstrates why PYREX tubes provide high heat transfer.

DISTRIBUTOR LIST

BELMONT, CALIFORNIA	Glass Engineering Laboratories
FRESNO 17, CALIFORNIA	Valley Foundry & Machine Works
NEW HAVEN, CONNECTICUT	Macalaster Bicknell Company
ATLANTA 1, GEORGIA	Will Corporation of Georgia
CHICAGO 44, ILLINOIS	Fred S. Hickey, Inc.
NEW ORLEANS, LOUISIANA	W. H. Curtin & Company
CAMBRIDGE 39, MASS.	Macalaster Bicknell Company
ST. LOUIS 4, MISSOURI	Stemmerich Supply, Inc.
LODI, NEW JERSEY	Mooney Brothers Corporation
ALBANY 5, N. Y.	A. J. Eckert Industrial Sales Corporation
BUFFALO 5, N. Y.	Will-Buffalo, Inc.
ROCHESTER 3, N. Y.	Will Corporation
HATBORO, PA.	Sentinel Glass Company
PITTSBURGH 19, PA.	Fisher Scientific Company
HOUSTON 7, TEXAS	W. H. Curtin & Company
SEATTLE 4, WASHINGTON	Scientific Supplies
TORONTO, ONTARIO, CAN.	Fisher Scientific Company, Ltd.
MONTREAL 3, QUEBEC, CAN.	Fisher Scientific Company, Ltd.
VANCOUVER, B. C., CAN.	Scientific Supplies

Corning means research in Glass

PYREX

CORNING GLASS WORKS

18 Crystal Street, Corning, N. Y.

Please send me the material checked below:

"PYREX brand 'Double-Tough' Glass Pipe and Fittings Catalog" (EA-3) ☐

"PYREX brand Glass Pipe in the Process Industries" (EA-1) ☐

"PYREX brand Cascade Cooler Bulletin" (PE-8) ☐

Data sheet on Fractionating Columns ☐

Name..... Title.....

Company.....

Address.....

City..... Zone..... State.....

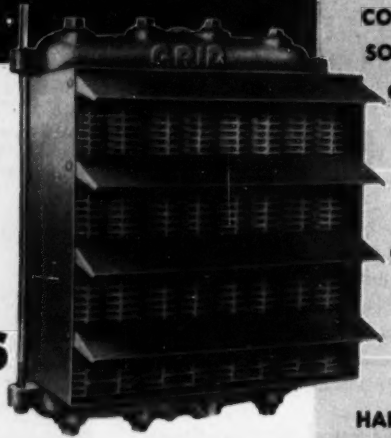
THE NATION'S LEADING . . .

Chemical Plants

RELY ON . .

GRID

UNIT HEATERS



. . . and here's why . . .

Grid is a completely different unit heater—all cast iron construction that stands up well against corrosive acid fumes of HCl, Cl_2, etc. GRID Unit Heaters have provided trouble-free service for over 24 years in the chemical industry-a record possible because:

GRID is an all cast unit with finned heating sections and headers tested to withstand steam pressures up to 250# P.S.I.

GRID construction uses no brazed, soldered, rolled or welded connections between condenser and headers. A specially designed threaded nipple assures a precision, leak-proof fit.

GRID construction has all similar metals in contact with steam, thus preventing electrolytic corrosion which eventually occurs in copper type unit heaters where steam passes from iron pipes into copper cores. (Write for booklet CORROSION IN UNIT HEATERS).

GRID construction resists corrosion from fumes present in most types of industry.

GRID design incorporating low outlet temperatures, proper fan sizes and motor speeds, assures delivery of warm comfortable air in ample volume to the working level. No stratification of warm air at the ceiling to waste your fuel dollars.

There are units cheaper than GRID but there is none better . . . you start saving money the day you install GRID Unit Heaters. Write today for complete catalog . . . also ask about GRID Blast Coils. They are ideal for many uses throughout the chemical processing industry (Catalog BC-1049).

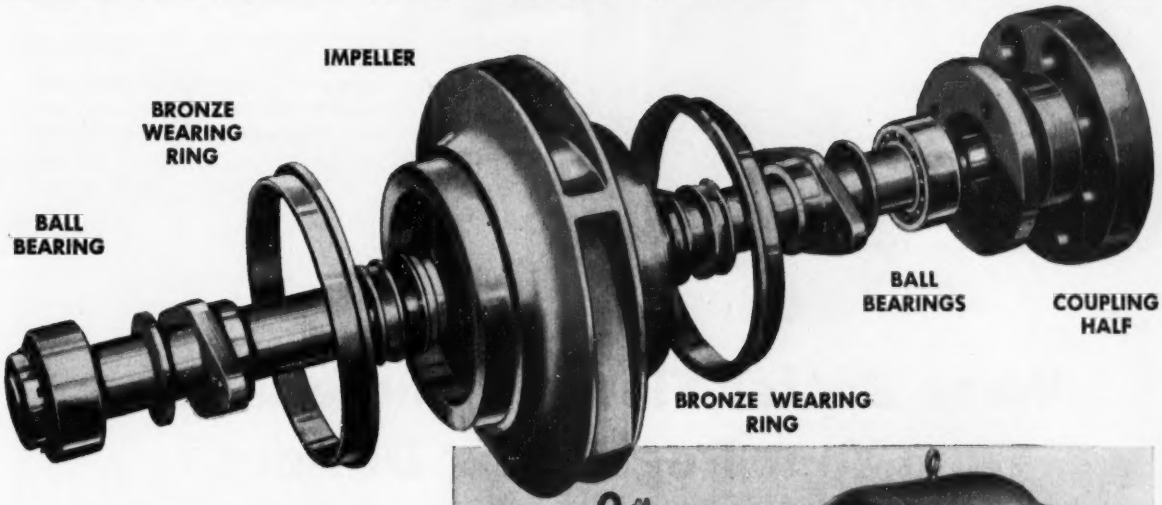
D. J. MURRAY MANUFACTURING CO.

Manufacturers Since 1883 • Wausau, Wisconsin

Representatives in all principal cities.

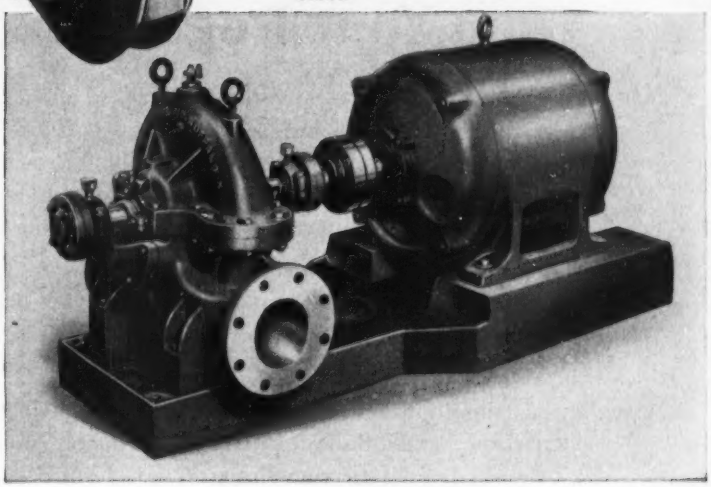
ABBOTT LABORATORIES	AMERICAN CYANAMID	ANSUL CHEMICAL CO.
BENZOL PRODUCTS	BUCKEYE COTTON OIL CO.	CLIFFS DOW CHEMICAL CO.
COLUMBIA SOUTHERN CHEMICAL CORP.	DAVISON CHEMICAL CORP.	DIAMOND ALKALI CO.
DOW CHEMICAL CO.	E. I. DuPONT de NEMOURS, INC.	GENERAL ANALINE & GENERAL CHEMICAL DIV. ALLIED CHEM. & DYE CORP.
HARSHAW CHEMICAL CO.	HERCULES POWDER	HOFFMAN La-ROCHE INC.
HOOKER ELECTRO-CHEMICAL CO.	MATHIESON CHEMICAL CORP.	MERCK & CO., INC.
MONSANTO CHEMICAL CO.	NATIONAL ANILINE	NAUGATUCK CHEMICAL
PHILLIPS PETROLEUM	SHARPLES CHEMICALS	STAUFFER CHEMICAL
	UNION CARBIDE & CARBON	VICTOR CHEMICAL WORKS

INSIDE STORY OF A BETTER PUMPING VALUE



IMPELLER-AND-SHAFT ASSEMBLY OF A "BUFFALO" DOUBLE SUCTION PUMP

Take a look at the "heart" of a clear water pump that is built for performance and endurance! Note the oversize shaft and ample ball bearings to stand the severest continuous-service strains. The double suction enclosed impeller is hydraulically balanced and has vanes and shrouds shaped for maximum efficiency. The two large bronze wearing rings on either side of the impeller prevent leakage, thus keeping efficiency high.



"Buffalo" Double Suction Pump

And in the pump casing, water passages are simply formed with ample area to avoid friction losses and sudden changes of velocity. (Top half of casing is easily removable without disturbing piping, for quick servicing of impeller and stuffing boxes).

Here is a pump that cuts your costs where economy really counts — in continued high efficiency, in freedom from breakdowns, in easy maintenance and the kind of lifetime performance you need on your pumping job. Write for Bulletin 955-P and check construction data on these pumps in sizes from 10 to 14,000 gpm.

"Buffalo" PUMPS

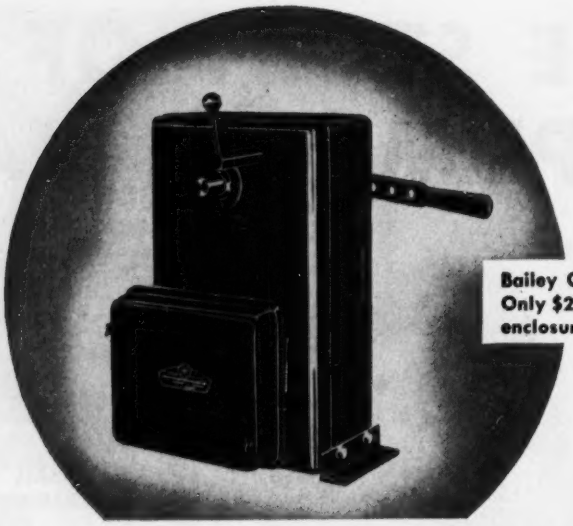
BUFFALO PUMPS, INC.

501 BROADWAY BUFFALO, N. Y.

Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



Bailey Control Drive, Type AC44P Model 200. Only $210.00 F.O.B. Cleveland, complete with enclosure, positioning relay and hand operator.

Want Better Flow Characteristics from Your Regulating Devices?

This new, small, piston-operated Bailey Control Drive will improve the flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders and similar regulating devices. Adjustment is simple; any desired relation between drive motion and pneumatic signal may be secured.

You can install this compact pneumatic drive power unit in any position on a column, pipe, or flat surface—and connect it to the regulating device with standard Bailey linkage, available from stock.

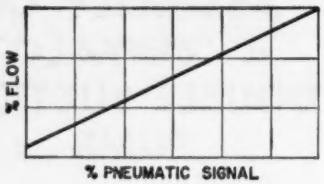
Speed (time required for full travel) is adjustable to suit your requirements. Bailey Control Drives operate on standard SAMA pneumatic signal ranges of 3 - 15 or 3 - 27 psig.

AVAILABLE FROM STOCK in 3 standard sizes

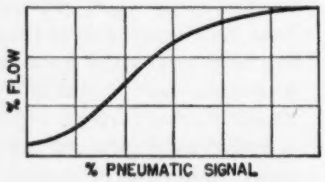
Type	Piston Dia. Inches	Piston Stroke Inches	Torque ft-lb	Max. Travel Degrees	Approx. Dimensions Inches
AC816	8	16	1500	90	13 x 27 x 51
AC68	6	8	400	90	13 x 19 x 34
AC44	4	4	75	75	10 x 11 x 19

P-28

The New Bailey Control Drive gives you THIS—



instead of THIS



BAILEY METER COMPANY

1054 IVANHOE ROAD

CLEVELAND 10, OHIO

Complete Controls for Process Plants

BAILEY METERS

Controls for

TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW LEVEL
RATIO

FOR MORE INFORMATION

FILL OUT AND MAIL

☐ I am interested in Bailey Control Drives. Mail me Spec. CA040.

☐ I am interested in Bailey Control Linkage. Mail me Spec. CA942A.

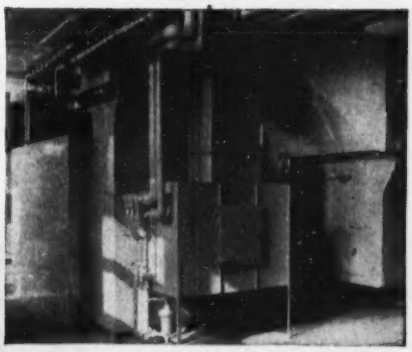
Name

Title & Company

Street & Number

City & Zone State

Lectrodryers serve low humidity areas in Pfizer plants all over the world



This air-conditioning type Lectrodryer maintains a constant 10% relative humidity in the antibiotic filtration room at the Groton, Connecticut, plant of Chas. Pfizer & Co., Inc.

Keeping relative humidity as low as 10%

The battle against contamination may be lost if control of vaporous moisture is not pinned down. Your best weapon is a Lectrodryer*. It can maintain bone-dry conditions in a room, over a process, throughout a laboratory and in air or gas lines . . . without disturbing required sterility. It reduces moisture to a harmless level below the point where hygroscopic materials would be affected or their flow interrupted.

Lectrodryers are helping to protect Pfizer quality in the United States, England, Belgium, Spain, Japan and South America.

Lectrodryers use Activated Aluminas to adsorb moisture from air, other gases and organic liquids. They efficiently reduce dewpoints to below −100°F . . . reduce relative humidity to as low as 5%. They can work under pressures as high as 6000 psi. Maintenance is minimized because these machines have few moving parts and Activated Aluminas will not wear out.

Perhaps you can benefit by reading Lectrodryer literature or talking with Lectrodryer engineers. Write for *Because Moisture Isn't Pink*, a booklet describing how industries are using Lectrodryers. Request any DRYness engineering information. Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

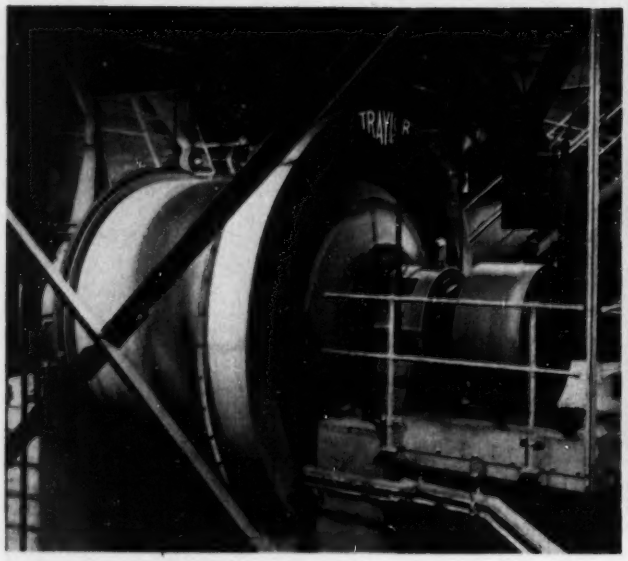
LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

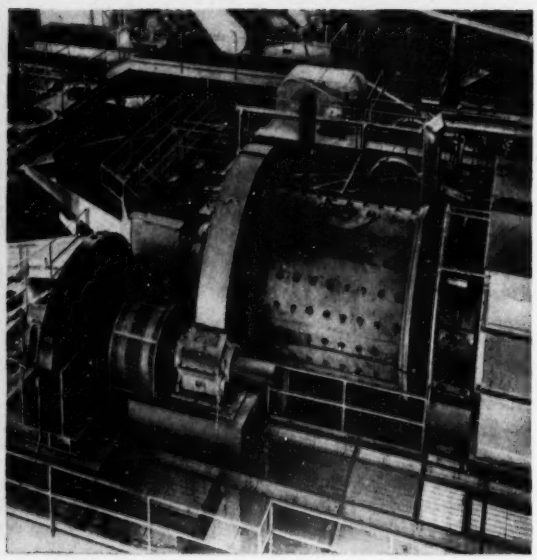
LECTRODRYER

* REGISTERED TRADEMARK U.S. PAT. OFF.

new grinding requirements

indicate a need for "Traylor-Made" Grinding Mills





TRAYLOR ENGINEERING & MANUFACTURING CO.
671 MILL ST., ALLENTOWN, PA.

SALES OFFICES: New York • Chicago • San Francisco
CANADIAN MFRS: Canadian Vickers, Ltd., Montreal, P. Q.

A "Traylor-Made" mill is probably the answer to my current grinding problem. Send me bulletin 8121.

Name _____

Company _____

Address _____

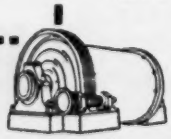
• *Traylor leads to greater profits*

In producing a new or improved product, consider carefully your grinding operation. Trying to use mills originally installed to grind other products may prove to be an expensive economy. Just as every material you produce has to meet certain finished specifications, the mill used to grind that material must possess certain individual characteristics. No grinding mill can possibly be as efficient and economical to operate as a mill "Traylor-Made" for its special process. Traylor Bulletin 8121 will show why a "Traylor" leads to greater profits. Mail the coupon for your copy today.

Primary Gyratory Crushers

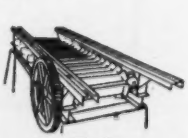
Rotary Kilns

Secondary Gyratory Crushers



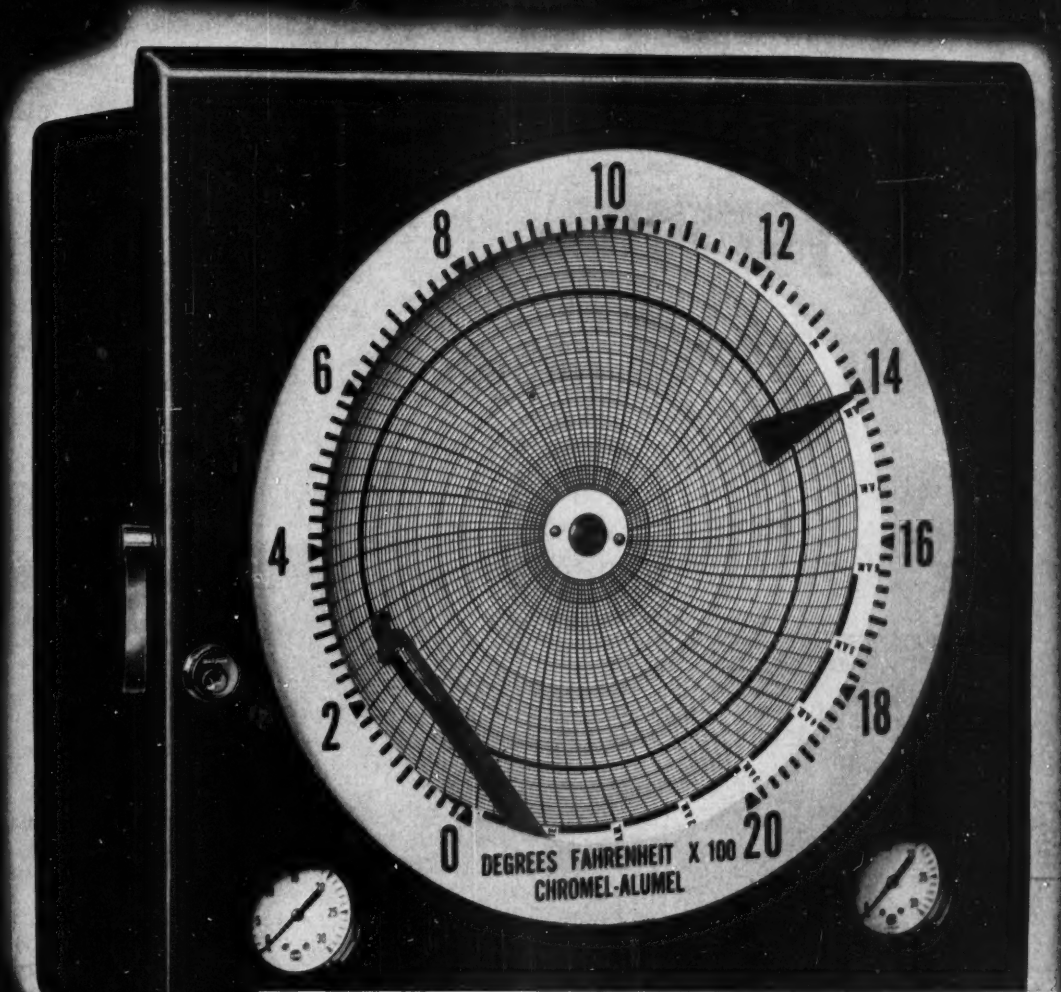
Ball Mills

Jaw Crushers



Apron Feeders

PROCESS INSTRUMENTATION



General Electric Announces . . .

NEW RECORDING CONTROLLERS

Featuring Reduced Maintenance and the "Magnetic Standard"

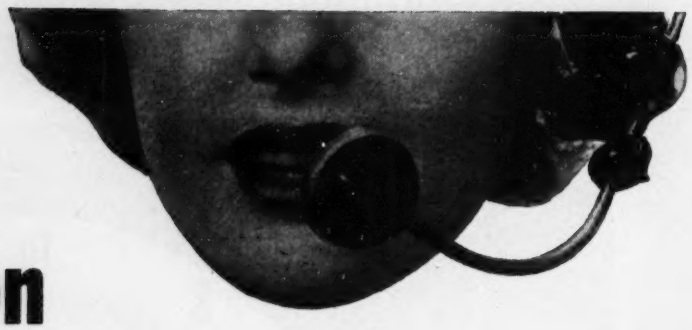
General Electric's newly designed recording controllers give you reduced maintenance through the "Magnetic Standard" in potentiometers and an improved bridge balancing unit in a-c bridge instruments. Eliminated are dry-cell batteries, standard cells and sliding contacts.

THE "MAGNETIC STANDARD" provides truly continuous standardization, as there is no lapse of control during standardization periods. This is especially important where a momentary loss of control has adverse effects on the quality of your product.

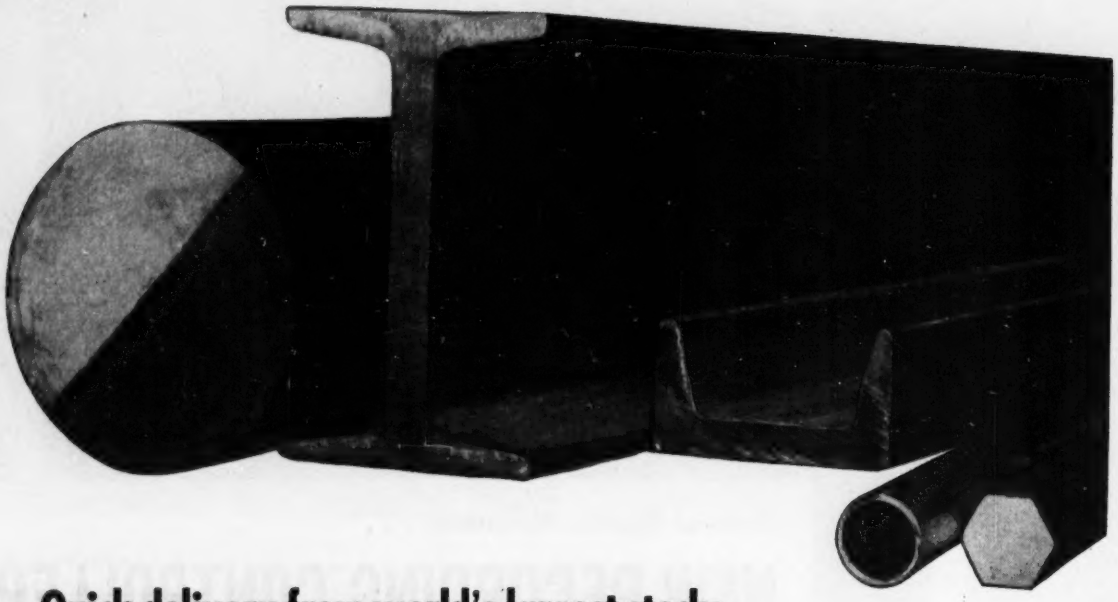
FOR FURTHER INFORMATION contact your nearest G-E Apparatus Sales Office or write for bulletin GED-2100, Section 602-284, General Electric Company, Schenectady 5, New York.

Progress is our most important product

GENERAL ELECTRIC



call Ryerson for steel carbon, alloy, stainless



Quick delivery from world's largest stocks

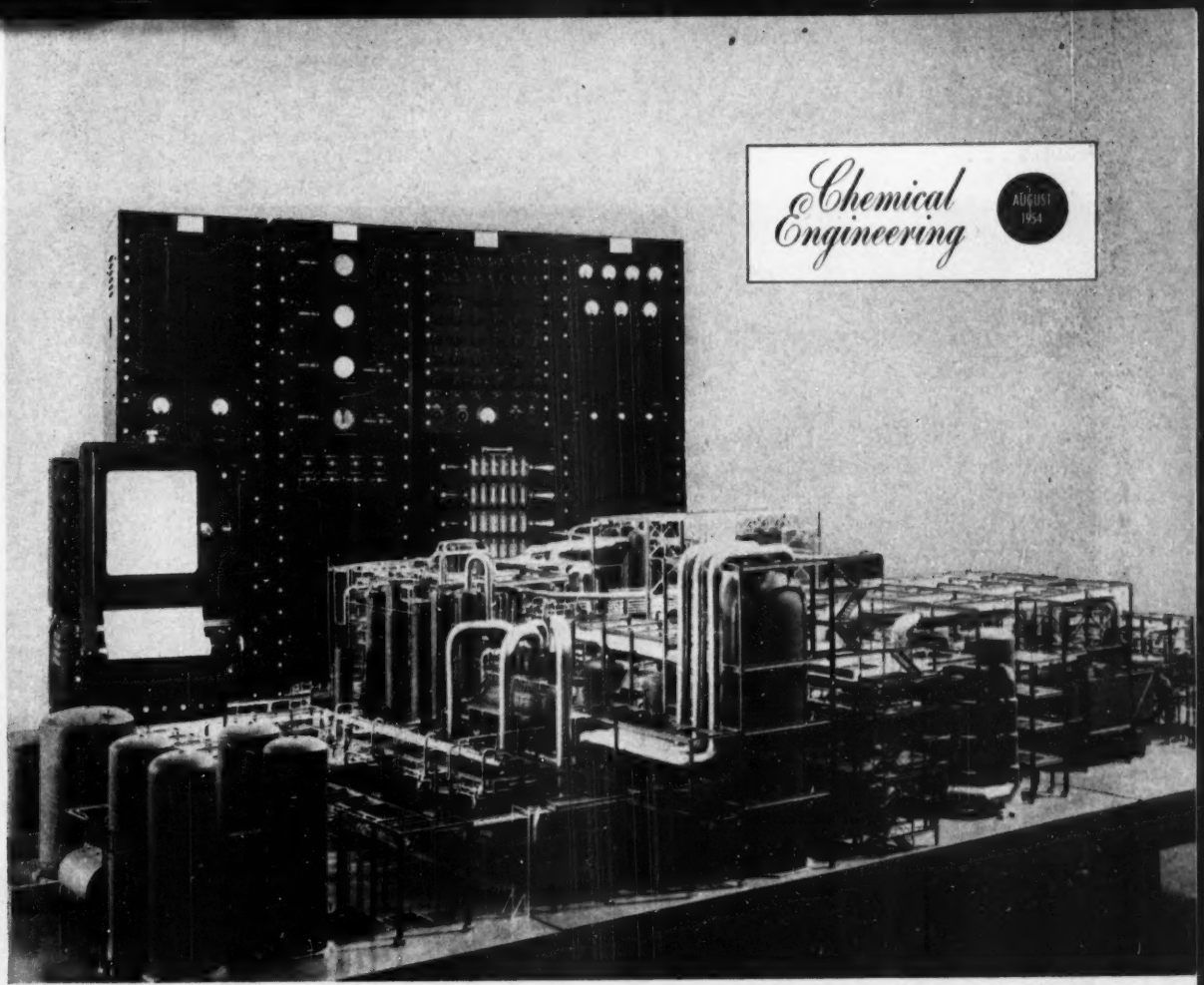
Whether you need a single piece or a truckload you can depend on prompt, personal service from your nearby Ryerson plant. So, for every kind of steel—when you need it—call Ryerson.

RYERSON CERTIFIED STEELS

RYERSON STEEL

Principal products in stock: bars, structurals, plates, sheets, tubing, alloy & stainless steel, reinforcing, etc., also machinery & tools

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • CHARLOTTE, N. C. • CINCINNATI • CLEVELAND DETROIT • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO • SPOKANE • SEATTLE



Engineering With Models

Industrial models are being used more and more in chemical industry. Here is a comprehensive report on two important types—scale and test.

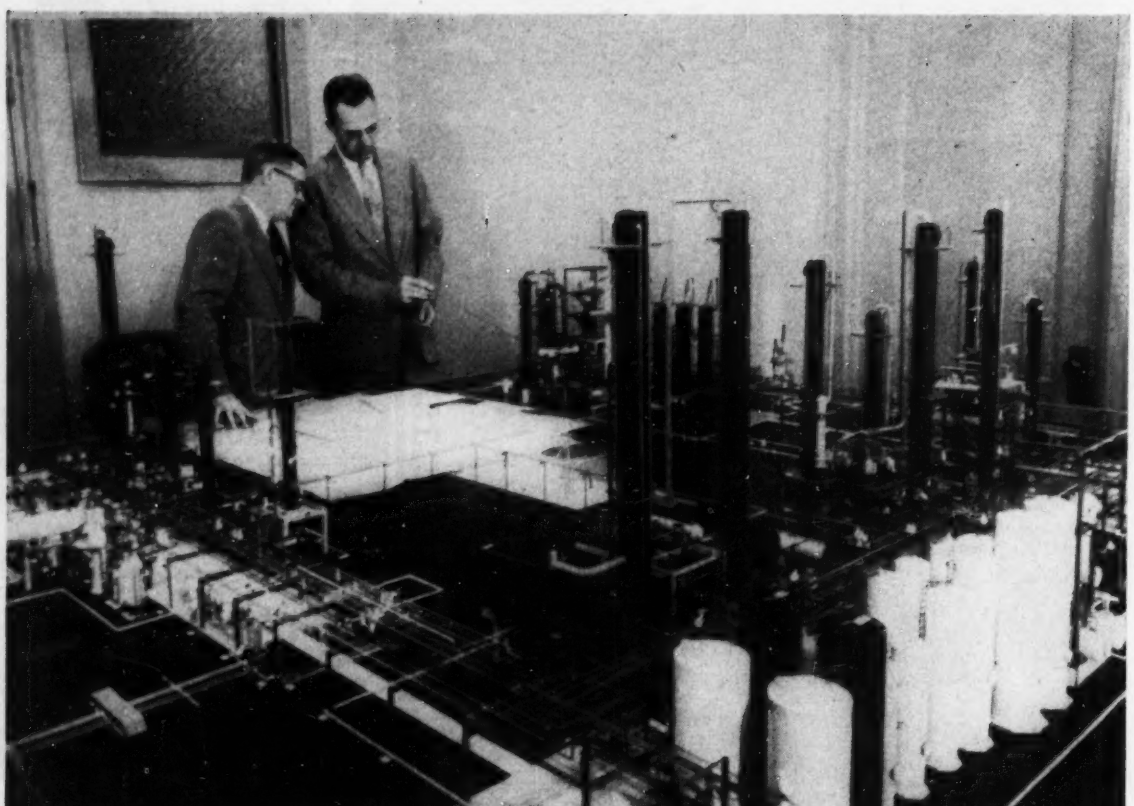
Use of industrial models is by no means a new idea to the chemical industry, or to industry in general. But it has only been in the last few years that the idea of models—as research, design and construction tools—has gained general acceptance throughout the chemical process industries.

This report deals with two important applications of models.

The first has to do with scale models—how they are used in the design and building of chemical plants. There are various kinds, but the "engineering" scale model is by far the most important engineering tool.

The second part takes up a different concept of models. It is the test or "scale-up" model. A chemical pilot plant falls into this classification. So does a wind tunnel, or an electrical analog machine.

These two concepts are closely tied in to the broad field of chemical engineering. Scale models are finding wide acceptance as a valuable tool for the building of chemical plants. Test models are closely connected with process research and development—work that precedes design and construction.



Scale Models

For design, construction and training, scale models of chemical plants are proving to be valuable time and money savers. Here's how to use them correctly.

H. J. BOWEN

The use of industrial scale models is not a new concept. As an engineering and structural tool, they have had wide application in ship building, architectural design and mechanical mass production.

But, until recently, the chemical industry has been relatively slow in adapting the use of scale models to design and construction work.

JEFF BOWEN heads up Industrial Models, Inc., Wilmington, Del., which he organized in 1948. Before that he was 7 years with DuPont.

Chemical plants are complex and costly. It is this complexity and high cost that has been the incentive, as well as the deterrent, to the widespread use of engineering scale models.

Our present period of industrial expansion has acted as the incentive. Costs of plants has steadily gone up, and the shrinking dollar has increased investment per pound of production.

The Case For Scale Models

Today's designer is caught between the demands for lowering engineering costs; good design for new complex plants; and a shortage of competent engineering talent. He needs a new engineering tool. A technique that will reduce design, capital and maintenance costs, that will speed up construction and operator training for faster start-up—and still result in a well designed plant.

More and more he is turning to the use of engineering scale models to help him achieve these goals.

Ten years ago such a decision would have been difficult to make. At that time chemical plant models were expensive toys. They were built from final drawings and attempted to duplicate every complex detail. The cost was high—the timing late.

This dual problem of model cost and timing has largely been solved by a number of model makers in this country. It's been done by merging the knowledge of engineers having design, construction and operating experience, with that of craftsmen.

What has evolved is the develop-

ment of standardized techniques for building models; and the elimination of the showing of unnecessary details.

Essentially, the scale model is a three dimensional planning tool. To understand how it can be used, let's trace the different phases of a scale model, as they develop during the design and building of a chemical plant.

Engineering Model

We will be describing a particular type of model, called an "engineering" model. Actually a model may be started at any time during design, or even after design is completed.

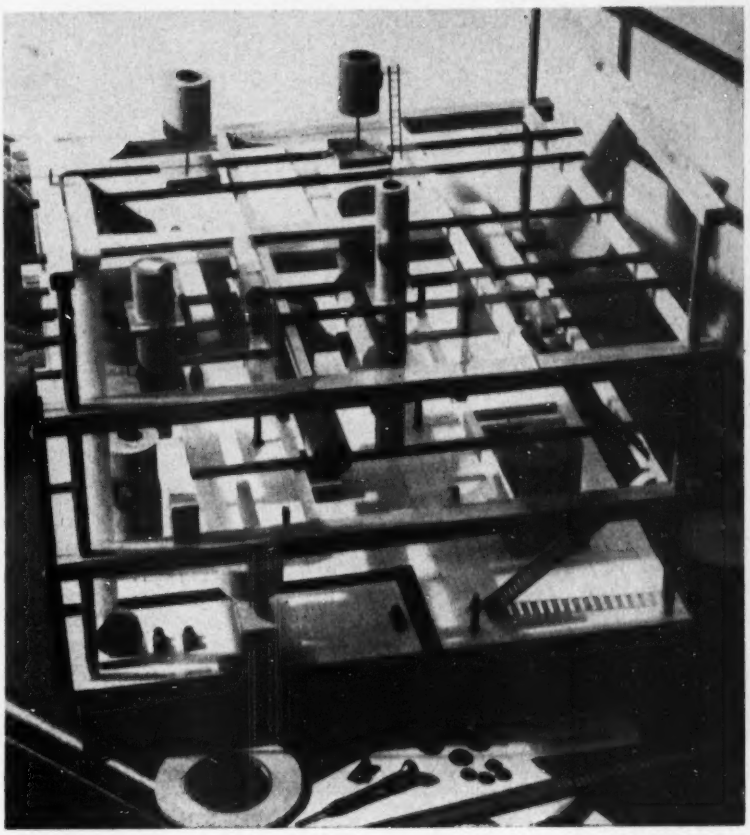
A model built after design is completed is termed a "training" model. It is useful for detecting interferences; training operating labor. And it may be useful for construction if it is completed in time for the pipe erection crew.

The cost of the training model is usually about 0.1% of plant investment and its justification is generally based on operator training. It's built from checked drawings and reveals relatively few errors if a good checking job has been done by the designers. If the model detects serious errors, these must be corrected—usually delaying plant startup. Minor errors detected by the model are usually not corrected—the owners prefer to live with the errors, rather than delay startup.

The training model thus has limited design value. But the engineering model (a model built ahead of, or parallel with the blueprints) can be of considerable value to the designer. The engineering model not only detects design errors early in the game —but tends to prevent errors creeping into the design in the first place. This engineering model costs about twice as much as the training model, because it is being continually revised.

Phases of Scale Model

First, a preliminary, engineering model is built from flowsheet data. It consists of a fictitious structure and movable equipment. Bay sizes and floor elevations may be quickly changed. Stairs, platforms, ladders, ventilation ducts, manholes, are fastened down with pressure sensitive tape. The model is used to establish optimum equipment arrangement and minimum building. The major equipment can be quickly changed at this stage.



PHASE ONE. A preliminary engineering model is made, based on flowsheet data. It's held together with tape and can be quickly changed.

Next a basic model is built quickly (without waiting for steel and equipment details) and moved to the design office. Major layout designs have been made on the preliminary model and used to build the basic. Design is flexible at this stage of the development. Equipment on the basic model is still movable. The model is revised on the spot if steel and equipment drawings later dictate it. Usually the base is laid off in ¼ in. squares and a ¼-in. scale is normally used.

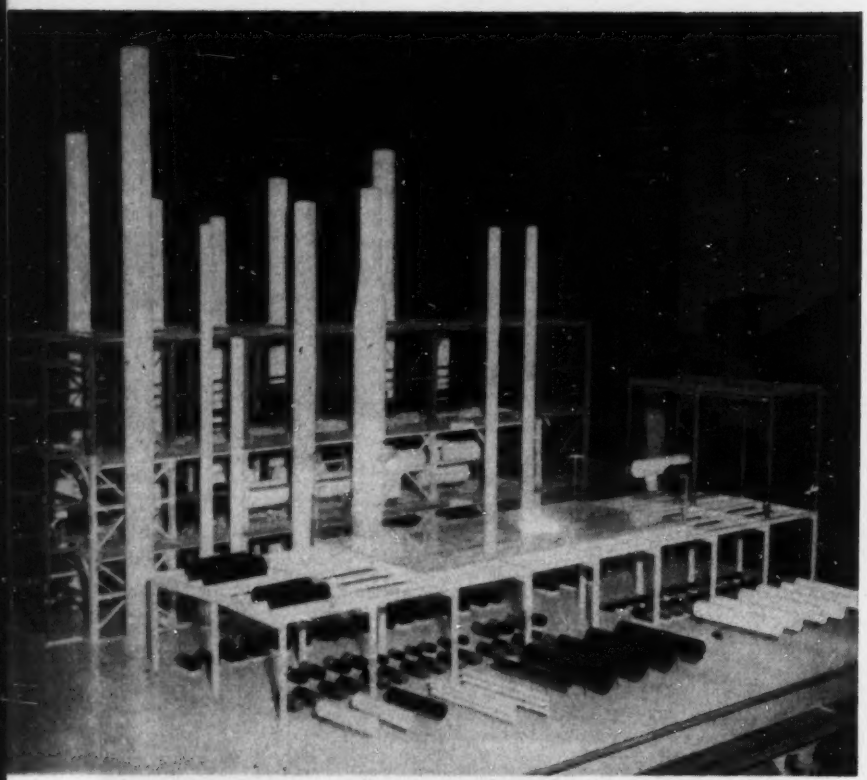
The third phase involves piping design. The modelmaker (who is also a design engineer) and the piping designer lay out the piping systems in the model—working from flowsheet data. All important pipes, valves and instruments are shown. Pipe is depicted with thin brass wires, each containing several discs to represent outside diameters (including insulation).

Piping drawings are not made until after the model has been reviewed and corrected by operating, maintenance, and construction personnel. Piping drawings are much cheaper, since they are simply copied from the model.

In the fourth phase, the model maker strips out the fine wires, and working from the drawings, installs full size (to scale) piping. This serves as a check on the drawings. Piping is coded; red for steam, green for water, etc. This fourth phase is optional.

In the fifth phase, the model is sent to the construction crew. Here it is used by subcontractors in preparing their bids; by construction people in planning building schedules.

In the sixth phase, it's sent to the manufacturing department and helps in the training of operating, maintenance, and supervisory personnel.



PHASE TWO. The basic model is quickly made up from the preliminary, and sent to the design office. There is still no steel or equipment details.

Savings From Using a Model

No way has been found to make a quantitative appraisal of model justification. However, a semi-quantitative analysis can be made from the following data, which is typical for the process industries.

Estimated savings are based on the assumption that the engineering model is used in series by designers, construction forces, and operating personnel. In Table I you'll see seven specific savings that a model can make in an ideal application. These savings are not made on all projects. Some savings depend on contractual arrangements (between owner and contractor) and some of them upon the contractor's method of operating.

Practically all chemical companies contract major new construction projects. Many contract design work.

Piping Drawings

The first savings item of $150,000 represents the theoretical reduction of piping drawing cost for a typical $10 million chemical plant, processing fluids. Such a plant will contain around $2-million worth of pipe and the cost of piping drawings is normally around $300,000. A model can theoretically save half of this or $150,000. This estimate is based on Table II which shows the statistical result of modeling 22 large projects for a dozen chemical and oil companies.

Job #1 had 849 pipes in the flow diagrams and in the completed plant. While this piping was being designed, 1,203 revisions were made to the piping arrangement, representing a revision frequency of 141%. The average revision frequency for these 22 projects was about 100%—which means that each pipe line on the average was designed twice.

There are usually good reasons for making the revision, i.e., to shorten up the pipe run, or to obtain better access for operations, etc. Small percent of changes are made by the "perfectionist" who keeps changing the pipe layout to get insignificant advantages. It is the function of the leading designer to restrain the "perfectionist" if the piping drawings are ever to be completed.

If these statistics are average for the chemical industries—and we believe they are—it is fair to infer that the cost of the piping drawings is approximately doubled if the average pipe run must be designed twice.

Many man-hours are required to reroute the average pipe run on paper. Several drawings usually have to be changed. And the piping designer must check his new route for interferences with steel, concrete, electrical features and even other piping in the vicinity. This is an extremely tedious operation on paper and frequently one or two man-days are required to route a single pipe line.

If piping is routed in a model instead of on paper there will be just as many pipe revisions but they will be made in minutes instead of hours.

In actual practice the model does not usually produce the full theoretical saving on piping drawings—because there is opportunity to make more and more pipe revisions to get the best possible pipe route for both operations and maintenance. This simply means the owner usually prefers to forego the saving in order to improve design quality; future operating and maintenance costs being far more important than the initial engineering cost.

Table I—Process Plant Cost Elements

Plant cost	$10,000,000
Pipe	2,000,000
Earnings (before taxes)	15,000/day
Engineering	1,000,000
Piping drawings	300,000
Training model	10,000
Engineering model	20,000
Possible model savings	
Piping drawings	$150,000
Pipe & fittings	33,000
Subcontracts	100,000
Operator training	10,000
200 Design errors	?
Faster construction	?
Startup	15,000
	$308,000+

The piping drawings which are prepared from the final model are practically free of revisions since all the revisions have been made in the model. Consequently, drawings are much cheaper. The piping drawings may be copied from the model by less experienced draftsmen, tending further to reduce cost of drawings.

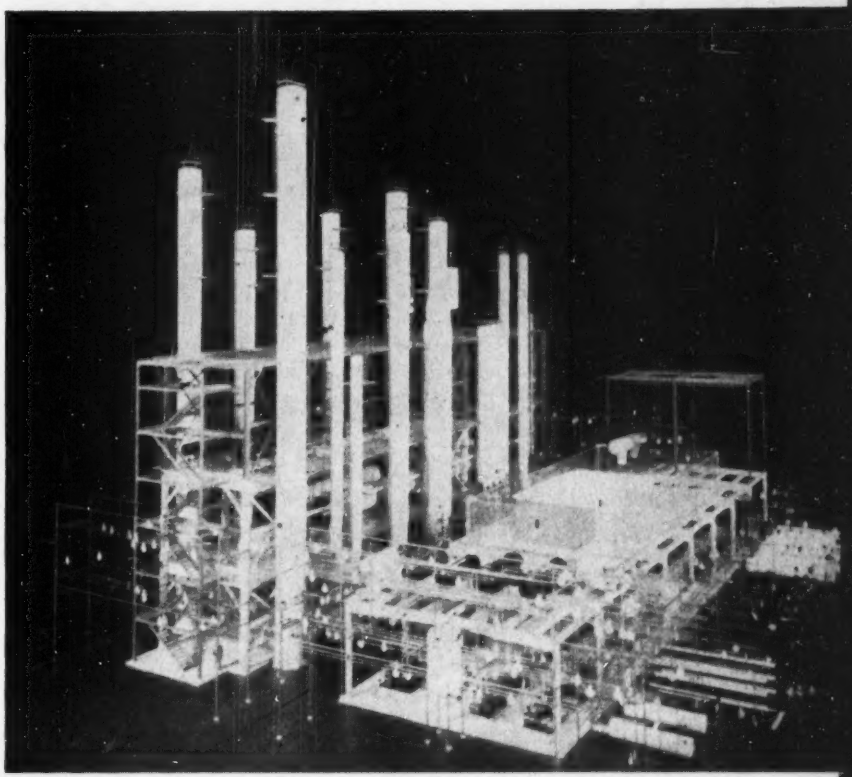
Furthermore, double-line piping drawings are definitely unnecessary to detect interferences. Some designers double-line only very large pipe (18 in. and up) while other designers traditionally double-line even the very small pipe (2 and 3 in. dia.). One of the largest process designers, who starts double-lining pipe at 6 in. dia., estimates that such double-lining increases piping drawings cost by about 10%. "Double-lining" is the practice of showing pipe diameters with two pencil lines, instead of just showing centerline of pipe (single-lining). The model definitely obviates this expense and appears justified by this item alone.

Pipe and Fittings

Table I indicates the model can save up to $33,000 on pipe and fittings. Let's say our average plant will have about 1,500 pipelines with an average diameter of 3 in. and about 5,000 elbows and tees.

Table II—Piping Revisions

Job	Final Pipes	No. of Revisions	Revision Frequency
1	849	1,203	141%
2	773	749	96
3	673	294	44
4	1,032	1,439	142
5	499	155	25
6	374	158	42
7	612	466	76
8	152	18	12
9	622	669	106
10	1,099	622	57
11	756	510	68
12	473	261	55
13	777	671	86
14	488	474	97
15	286	526	182
16	111	142	128
17	488	757	153
18	1,117	1,568	140
19	526	457	87
20	1,580	1,740	111
21.	219	462	210
22	745	1,016	136



PHASE THREE. Working together, the piping designer and the modelmaker develop the piping (thin wire) on the model. Drawings are then made from the model.

By routing pipe in the model and eliminating the extra bends, it's estimated that about 20% of the elbows, i.e.; 1,000, can be saved. This represents $33,000, since a 3 in. carbon steel elbow welded in place (minus insulation) costs about $33. The piping designer working on paper without benefit of model seldom gets the shortest pipe route due to the sheer difficulty of visualization.

In contrast, the designer working with a model can immediately see the shortest route and will install a length of wire representing this route. He then modifies this to fit the process, after taking into consideration chemical and physical variables and stress requirements. He winds up with the shortest possible route compatible with the process.

Subcontract

The figure of $100,000 is a "guesstimate." It is based on several reports from Singmaster & Breyer,[3] Bakelite Division[4] and others.

These reports indicate subcontract savings are very much larger than claimed here, but the reports are too few in number to be represented as average. Anywhere from 10-50% of plant investment is commonly subcontracted and may include piping, electrical work, instrumentation, painting and insulation.

Estimates for this work are invariably prepared from study of complex drawings where the estimator cannot see what his working conditions will be. To protect himself, he includes an "ignorance" contingency in his bid. The same estimator, if preparing the bid from a model, can easily foresee scaffolding requirements, necessity for working in crawl space, and the precise scope of work. He does not need to guess and can turn in a lower bid. No one but the subcontractor knows the magnitude of the "ignorance" contingency but it is believed that 5-10% of the bid would be a conservative guess.

Thus, where subcontractors are bidding on half of a $10 million plant and we assume their ignorance contin-

gency is 5%, they are adding $250,000 to their bids.

Assuming a model makes a saving on subcontracts, who gets it? The general contractor gets it if he has a lump sum contract with the owner. The owner gets the saving if it is a cost-plus job. The large general contractors usually subcontract only the insulation and electrical work since they have facilities for handling other types of work. The small general contractor, however, may have to subcontract everything, so the amount of the saving will depend on contractual arrangements and who is handling the job.

Operator Training

It is conceded by all who use models that they are useful for training new operators. When operator training begins, the new plant is usually completed, so why have a model at all; why not train the operators in the full-scale plant.

There are two reasons—the minor one being that operating people get in the way of construction people just finishing up the job. The major reason is the fact that an operator looking at the color-coded pipe in the model can see where the pipe starts and where it ends; he can see the entire building and all of the equipment at one time, making it possible for the supervisor to quickly orient him on both process and equipment.

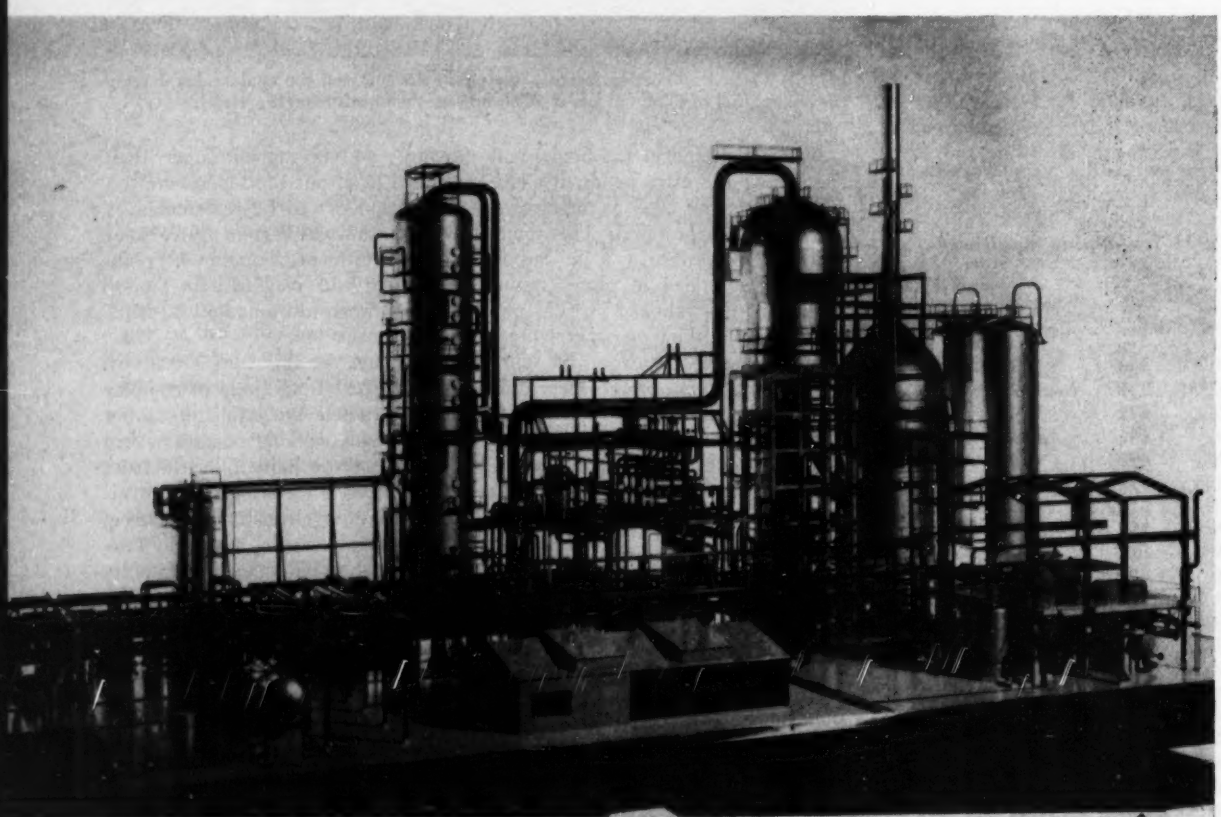
Alternatively, if he takes the trainee by the hand through the real plant he quickly gets lost in the jungle of pipes and equipment. Scores of models have been sold purely for this training purpose and it is safe to assume that the buyer has saved at least $10,000. This will approximate the cost of a training model for a $10 million plant.

Two Hundred Design Errors

It has been the practice of model makers to maintain daily records on number of pipes installed in the model, number of revisions, design errors detected, etc. These records show that a model of a $10 million process plant built from unchecked drawings will turn up approximately 200 design errors, of which 40-50% are actual interferences. The balance represent inaccessible valves and instruments, dimensional discrepancies, etc. This assumes the designers were experienced and no complex structures were involved. Where inexperienced designers or complex structures enter the picture the number of errors found is much greater. The number of errors is proportional to plant size.

Admittedly, a good checker will detect perhaps 98% of these errors in the drawings, but he catches them too late. Serious errors, of course, must be corrected, usually delaying the plant startup.

Minor errors usually are never corrected; the owner prefers to live with them rather than postpone startup.



PHASE FOUR. Wires are removed and full scale size piping put in. This is done from the drawings—and is a good check on their accuracy. The model is complete at this point, although changes can still be made.

These minor errors increase operating and maintenance cost. An accurate model will catch all of these errors and furthermore, will catch them sooner than the checker can.

Very few errors creep into the design when an "engineering" model is used. Because each design group can easily check the quality of their work, e.g., the steel designer will spot oversize beams, the electrical designer will see lights behind steam mains, the concrete designers note oversize pads and footers, etc. The detection of interferences is automatic.

Operating and maintenance people point out inaccessible manholes, instruments, etc. For the first time, this latter group can readily contribute to the design of the plants they must operate and maintain. All model users agree that this is a major contribution to design quality.

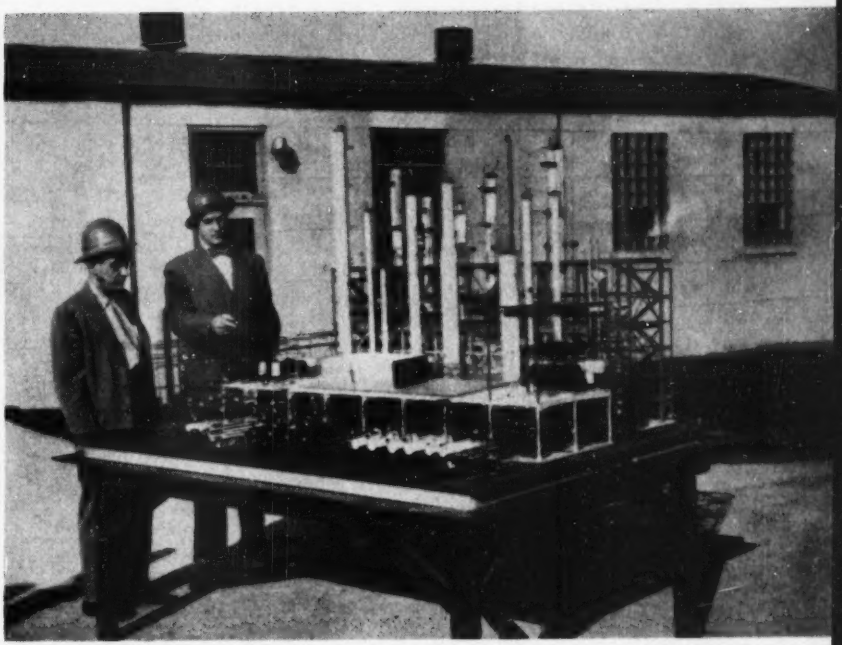
Faster Construction

Speed and cost of a construction project greatly depend on how skillfully the work of the various crafts (electricians, painters, pipe fitters, masons, steel workers, millwrights, etc.) has been planned and scheduled. It seems self-evident that such planning and scheduling can be done faster and more accurately by using a model and reports from various field groups confirm this. Specifically, how is a model used in the field?

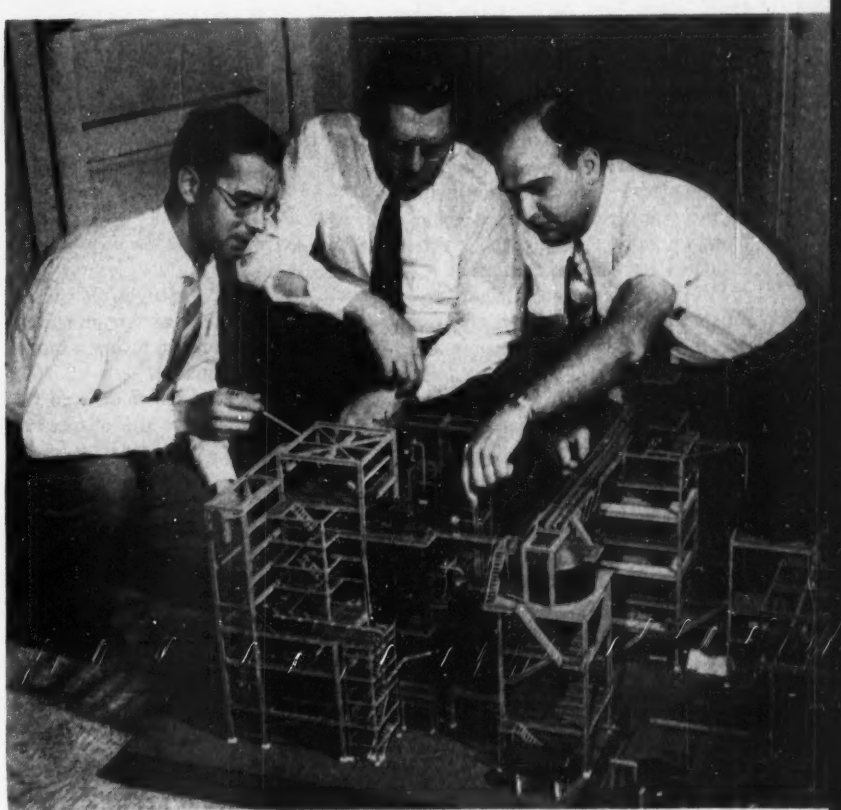
The field planning group should analyze the model in an attempt to visualize the work of all crafts and to insure a smooth and efficient job. Some items to be investigated are:

a. Can scaffolding costs be spread over two or three crafts' work?
b. When is it most advantageous to start insulation, painting, etc?
c. How many crafts can reasonably work in a given area at the same time?
d. Can erection sequence be improved for: labor usage, equipment usage, time advantage, material handling, safety, craft integration, storage facilities, etc?

Prior to holding construction meetings, engineers and foremen should check proposed work on the model to eliminate errors of omission, duplication and conflicts. Use the model (or projected pictures) to explain to the audience the proposed work and ob-



PHASE FIVE. It goes to the construction crews. The three-dimensional blueprint helps in the scheduling of erection of equipment.



PHASE SIX. The operating boys now take over. They can accomplish some of the training of operating personnel right on the model. The result is fast start-up.

jectives. Areas of interest may be highlighted by running colored ribbons from the model to a blackboard containing various legends.

To minimize jurisdictional disputes between crafts, define the scope of work of each craft (in advance) by pointing it out on the model.

Fabrication of Pipe

The model should be in the pipe shack for use of draftsmen, who are working up piping fabrication drawings. Draftsmen can make rough isometric sketches of complete pipe systems from the model, adding dimensions from the prints. Foreman, engineer and draftsman can analyze sketches (using model as a guide) and decide location of field welds and break flanges.

Erection of Pipe

For pipe erection, locate the model as close to the work as practicable. Foremen can study their work on the model, analyzing the problems of labor, material handling, equipment, tools, space, etc., to eliminate omissions, conflicts and work duplication. They can study the erection sequence for errors and economy—check other crafts' work in area for conflicts and necessary completed work—determine where materials, tools, and equipment will be placed—get the overall picture of the complete job; and develop a tentative work schedule and erection sequence for the erection crew.

Where drawings are incomplete or indeterminate construction crews can use the model to clarify pipe runs, valve orientation.

Work progress can be quickly seen if colored tags are affixed to each model pipe as it is installed in the field. Other tags can be used to indicate which vessels and pipes have been tested.

Construction is further expedited by eliminating superfluous pipe and elbows, interferences and other errors from the design, as mentioned previously.

No attempt is made in Table I to evaluate savings resulting from faster construction and early detection of design errors. These savings in isolated cases have exceeded all the other savings combined. Occasionally a drastic design error can be evaluated in dollars; but for the most part such savings estimates represent opinions not reducible to concrete figures.

Startup

When a $10 million plant must earn $15,000/day before taxes it is urgent that the plant operate at 100% capacity as soon as possible. This economic fact of life is the driving force behind the whole engineering effort.

Numerous bottle-necks prevent early plant startup. Among them are construction labor inefficiency; completion of drawings; procurement; last minute changes; interferences and other design errors. The model minimizes all of these bottlenecks except procurement.

An accurate model guarantees there will be no interferences and no physical design errors. If the model reduces design cost as indicated it follows that piping draws (which are last to go to the field) will be issued sooner. If construction planning and scheduling is improved as indicated—and if design errors are eliminated—construction efficiency is bound to improve, effecting an earlier plant completion date.

Most plants do not get up to 100% capacity promptly after startup because it is invariably found necessary to relocate valves, instruments, pipe lines, correct safety hazards, etc., in the field. These items can all be corrected in a model before construction ever begins. Construction supervisors report that these last minute changes are greatly reduced by permitting operating and maintenance people to review a model before construction.

Thus, use of a model early in design greatly improves the chances of getting up to 100% capacity at an early date. It's not possible to evaluate this advantage but it is believed that many plants have been started up several days earlier than they would have been without benefit of a model.

Pitfalls

Probably a great many models have been built which were not justified. Observance of this list of "don'ts" will assure justification.

1. Don't permit the model maker to include "gingerbread" or model details which do not have definite application. You cannot always justify showing lights, conduit, handrail, ladder cages, flanges, curbs, etc.
2. Don't force designers to use a model; they must be sold on it. After all, they have design methods which work, and they are reluctant to tamper with design schedules to try something new. This resistance is normal inertia to change, and is met with whenever any untried idea is proposed.
3. Don't permit the "perfectionist" to delay design with insignificant changes. The model gives him an unprecedented opportunity to do this. It is the business of the leading designer to remind everyone that this $10 million plant must earn $15,000/day.
4. Don't build the model too late. If you hope to get full engineering advantage, the model should be started as soon as approximate equipment sizes are known. A "training" model may be built after design is finished, but its utility is limited to training and perhaps construction planning.
5. Don't start piping studies until the flowsheets are reasonably firm, otherwise such studies may be wasted.
6. Don't perform piping studies on paper (except stress analysis) if a model is available. The latter is infinitely faster because you can see all the physical variables.
7. Don't permit the model to become out of date after it is delivered to the construction forces. There is always a dribble of piping changes going to the field after piping drawings are issued. If construction men find a few pipes in the model that disagree with latest drawings they will lose confidence in the model and will refuse to use it. The simple remedy is to keep the model up to date as long as design changes are coming through.
8. Don't make one group, e.g., design department, bear the entire model cost when other groups (construction, operations and sales) intend to use it. This produces resistance from the injured group.
9. Don't neglect to get written reports on model usage from design, construction and operating people. Such reports provide basis for future action.

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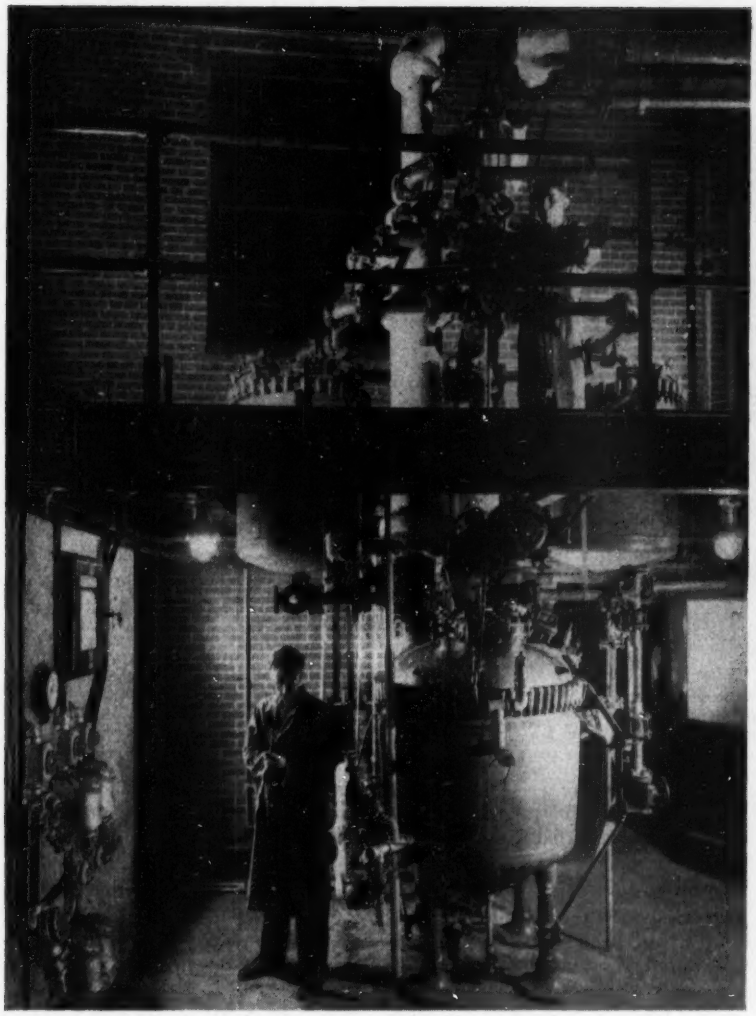


Test Models

A pilot-plant, an analog machine; some examples of test or "scale-up" models. Here is how you can use these techniques more effectively.

GLENN MURPHY

The engineer is constantly confronted with the necessity of making predictions concerning the behavior of physical systems. In the course of a single day he may be asked for predictions embracing a score of technical topics.

Can the operating temperature in a given phase of a process be increased ten degrees without disastrous results? Will an available stainless steel serve as well as the specified but unobtainable alloy? How much will the yield of a process be affected by changing the size of one of the units?

In making his predictions an engineer relies on one or more of several techniques. He may (1) apply a theory that has been developed for the situation; (2) rely on experience or a knowledge of what has happened previously in identical or similar situations; (3) modify previous experimental findings to fit the particular circumstances or (4) reason by analogy. The time involved in arriving at a dependable prediction varies from a few seconds to months depending on the individual and the problem.

The first method is analytical while the other three methods are fundamentally experimental. Greatest confidence in a prediction may result if the prediction is based on data obtained from a unit identical to the one under consideration. While conducting tests on a unit presumably identical to the one to be placed in service is perhaps ideal practical considerations limit this procedure to small units.

Testing a tentative design of a tool, a machine part, or even an automobile to determine how it will perform in service is practicable; but building an Empire State Building, a large dam, or a modern refining plant to determine whether or not the design is feasible is decidedly impracticable.

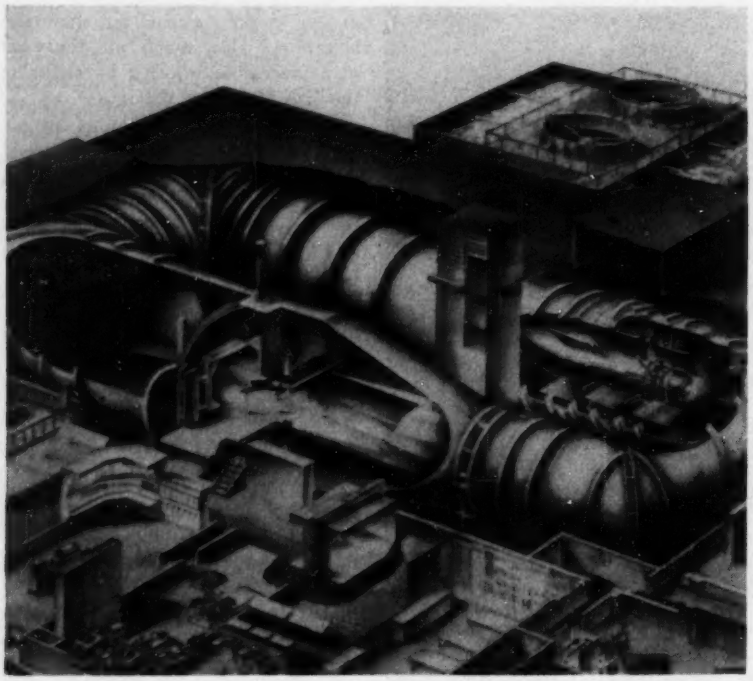
Types of Models

In order to check on the probable performance of a large unit it is common practice in many branches of engineering to construct and test a small replica of the unit. If the replica (which is called a model) is properly designed and tested it will yield highly accurate predictions of the behavior of the full-size structure, (or prototype).

Models that are used to predict the performance of the structure or plant under working conditions may be classified as (1) true models, (2) adequate models or (3) distorted models.

A true model faithfully reproduces every operating characteristic of the prototype. It must be geometrically similar to the prototype in every respect that influences its behavior. The ratio of any distance or length in the

PROFESSOR MURPHY is an authority on similitude problems. He is head of the Department of Aeronautical Engineering at Iowa State College.



WIND TUNNEL is a prime example of the use of test models. Plane models undergo stress and flow tests. Data are used to design full scale units.

prototype to the corresponding distance in the model is called the length scale.

An adequate model duplicates the prototype in all important respects, but may differ in minor details. For example, in a model of a building frame, circular rods might be used to represent the I-beams or other structural shapes in the prototype. However, significant distances in the adequate model will have the same length scale.

In a distorted model one or more significant distances, properties, or other characteristics are not scaled down the same amount as the rest of the corresponding units. The distortion may be intentional—but it is usually unavoidable.

How Models Are Used

All three types of these operating models have been used extensively in engineering to get data from which engineering predictions of the performance of the prototype could be made.

Over eighty years ago William Froude used scale models to evaluate the drag and the power requirements of ships, and reported on a technique for using models to isolate the skin friction portion of the drag. Modern towing tanks for evaluating the performance of water-bourne craft are several hundred feet long. They are equipped with electric carriages for pulling the models through the water at speeds exceeding 80 mph.

Aeronautical engineers make extensive use of models in wind tunnels for evaluating the aerodynamic forces and performance characteristics of aircraft. The tunnels range in cross section from less than 1 sq. in. to 40 by 80 ft.—the latter accommodating a small prototype airplane if desired. Operating speeds as high as several times the speed of sound are used in some tunnels.

For the last 20 years civil engineers have used models to assist in the design of large buildings, bridges and dams. The Empire State Building, George Washington Bridge and Hoover Dam are examples of structures for which the design was aided materially through the use of models. Silting, erosion and other problems associated with river and harbor control have been extensively studied by means of models. The Mississippi River has presented many problems for which model studies represented the only practical approach to a solution.

The performance of vast networks of interconnected electrical power lines under unusual loading conditions is under study at various laboratories by means of electrical network models. Hundreds of miles of transmission lines can be represented in a small space with electrical models.

Chemical Engineering Applications

The methods and techniques of using models for making engineering predictions have not been used as extensively as they could in the field of chemical engineering. The scale-up of an operation from the pilot-plant stage to the production plant involves the same principles that are involved in the scale up of any system from a model to a prototype. These principles can be used to advantage by the chemical engineer.

For the majority of chemical engineering applications, all of the conditions required for a true model cannot be satisfied. That is, a perfect replica of a plant cannot be built in miniature. Cost frequently prevents the construction of a full scale model as an aid to design with the result that the transition from pilot plant to production plant involves distortion.

A critical phase of the design is that of predicting what effect the distortion will have on the scaling up of the plant or process. Where the plant is to operate on a small competitive margin, an indication of the range of error of prediction is of paramount importance.

In some applications, empirical factors for adjusting the predictions to compensate for scaling a process up or down have been evolved; but there are also some advantages in looking at the problem from an analytical standpoint.

Basis of Model Analysis

It is assumed at the outset that a complete equation for the item to be predicted is not known—if it were known a model would be unnecessary. It's also assumed that the individual

factors upon which the item depends are known. That is, if a denotes the quantity to be predicted, and a depends on the factors $b, c, d, \ldots . s$, then

$$a = f(b, c, d \ldots .s) \qquad (1)$$

In all but the simplest of situations, several items will be involved on the right-hand side of Eq. (1), and it is first desirable to reduce the number if possible. This may be accomplished without any loss in generality by applying the Buckingham Pi Theorem. This theorem states that the phenomenon may be expressed in terms of n independent and dimensionless quantities, where n is equal to the number of initial variables involved, minus the number of independent dimensions in which they may be expressed.* Thus, Eq. (1) may be reduced to

$$\pi_1 = F(\pi_2, \pi_3, \pi_4, \ldots . \pi_n) \qquad (2)$$

To the uninitiated, Eq. (2) appears more, rather than less, formidable than Eq. (1). However, it has the advantage of being shorter than Eq. (1) and much more flexible. Equation (2) may be considered to represent the phenomenon in either the pilot plant or the full-sized process (that is, in either the model or the prototype) because the identical phenomenon is involved in each.

For convenience the subscript m will be assigned to quantities involved in the pilot plant (model), so for that unit Eq. (2) may be written as

$$\pi_{1m} = F(\pi_{2m}, \pi_{3m}, \pi_{4m}, \ldots . \pi_{nm}) \qquad (3)$$

However, the nature of the function F is identical in the two equations. For a true model, the design conditions are

$$\begin{aligned} \pi_{2m} &= \pi_2 \\ \pi_{3m} &= \pi_3 \\ \pi_{4m} &= \pi_4 \\ &\cdots \\ \pi_{nm} &= \pi_n \end{aligned} \qquad (4)$$

If these are satisfied the prediction equation follows directly and automatically as

$$\pi_1 = \pi_{1m} \qquad (5)$$

and the performance of the prototype may be predicted with an accuracy consistent with the model data.

*See *Chem. Eng.*, April 1954, pp. 185-190

HYDRAULIC MODEL of a section of the Hoosic River. Fluid flow studies determine best conditions for flood control and river improvement.

Distorted Models

In problems involving the flow of fluids—and this includes many Chemical Engineering applications—it is frequently impossible to satisfy the design equations, Eq. (4), simultaneously with a length scale other than unity.

For example, the friction head developed by a liquid being forced at a given average velocity through a tapered cylindrical column of closely packed uniform small spheres will depend on a number of variable, but it would be expected that a model could be built for the system. The major significant variables for a range of particle sizes are listed in the following:

Symbol	Quantity	Dimensions*
1. H	Friction head	L
2. v	Average velocity at reference point	LT^{-1}
3. d	Particle diameter	L
4. D	Cylinder reference diameter	L
5. a	Column length	L
6. ρ	Fluid density	ML^{-1}
7. μ	Fluid viscosity	$ML^{-1}T^{-1}$
8. g	Acceleration of gravity	LT^{-2}
9. θ	Angle of taper	—

* An absolute, rather than a gravitational, system of dimensions is indicated. Which system is used has no bearing on the problem or the final results. L, distance; M, mass; T, time.

Other factors, such as surface tension may also have an influence on the friction head, but are omitted here for simplicity.

According to the first premise

$$H = f(v, d, D, a, \rho, \mu, g, \theta) \qquad (6)$$

However, there are three basic dimensions (F, L, T or M, L, T) involved, so from the Buckingham Pi theorem, it follows that the phenomenon may be expressed in terms of 6 Pi terms. One combination is

$$\frac{H}{a} = F\left(\frac{d}{D}, \frac{a}{D}, \frac{\rho v D}{\mu}, \frac{v^2}{g D}, \theta\right) \qquad (7)$$

A similar equation may be written for the model

$$\frac{H_m}{a_m} = F\left(\frac{d_m}{D_m}, \frac{a_m}{D_m}, \frac{\rho_m v_m D_m}{\mu_m}, \frac{v^2_m}{g_m D_m}, \theta_m\right) \qquad (7a)$$

The resultant design equations for a model of the system are

$$d_m/D_m = d/D \qquad (8)$$

$$a_m/D_m = a/D \qquad (9)$$

$$\rho_m v_m D_m/\mu_m = \rho v D/\mu \qquad (10)$$

$$v_m^2/g_m D_m = v^2/gD \qquad (11)$$

$$\theta_m = \theta \qquad (12)$$

The conditions imposed by Eq. (8), (9) and (12) are geometrical conditions—and it will be recognized that there are clearly limits on how much difference there may be between d and d_m without introducing complications. However, a fundamental and more serious objection is found in the incompatability of Eq. (10) with Eq. (11), if it is proposed to use the same fluid in model and prototype. Under these conditions the density and viscosity of the fluid in the model will be the equal to the corresponding quantities in the prototype and Eq. (10) will reduce to

$$v_m = n\,v \tag{13}$$

in which n is the length scale.
Since the acceleration of gravity is the same in model and prototype, Eq. (11) will reduce to

$$v_m = v/\sqrt{n} \tag{14}$$

Obviously Eq. (13) and (14) are compatible only if the length scale is unity—that is, if the model and prototype are the same size. If they are not the same size, distortion will result.

It will be assumed that the conditions indicated by Eq. (8) and (9) can be satisfied, and that it is convenient to scale down the velocity in the model to satisfy Eq. (11) or (14). The problem is now one of taking into account the distortion of Reynolds Number, or the fact that Eq. (10) is not satisfied. Equation (10) must be replaced by

$$\rho_m v_m D_m/\mu_m = \alpha(\rho v D/\mu) \tag{15}$$

in which α is the distortion factor.

The prediction equation for a true, or undistorted model

$$H/a = H_m/a_m \tag{16}$$

must be replaced by

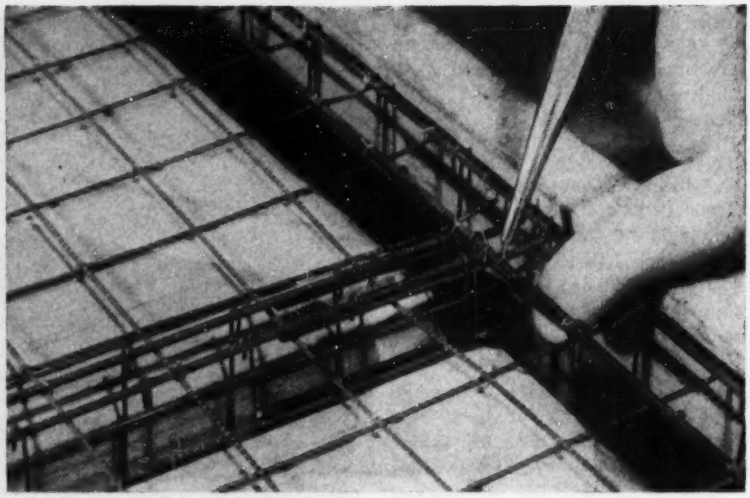
$$H/a = \delta(H_m/a_m) \tag{17}$$

in which δ is the prediction factor.

Experimental Determination

The prediction factor δ may be evaluated experimentally or analytically. Equation (17) shows that the experimental evaluation of δ requires knowledge of the four factors H, H_m, a, and a_m. That is, there must be a pair of matching tests on two systems. However, these do not necessarily include the actual prototype or full-scale unit.

In fact, the only requirement is that one of the two systems have the same distortion with respect to the other that the model has to the prototype. In effect, a model of the model may be built having the same distortion as that existing between the model and prototype and the prediction factor determined from observation on the two models.



MODEL of steel reinforcing members in concrete slab. Data used for building . . .

In certain cases it may not be convenient to construct a second model having the same distortion factor with respect to the model that the model has with respect to the prototype. But may be possible to construct two supplementary models with different values of α. From observations on these, a curve of δ vs. α may be plotted, and the value of δ for the prototype determined by interpolation.

Analytical Determination of Factor

The prediction factor, δ, can be evaluated analytically if certain information is available concerning the effect of the distorted variable. For example, if it is known that Eq. (7) may be written as

$$\frac{H}{a} = F_1\left(\frac{\rho v D}{\mu}\right) \times F_2\left(\frac{d}{D}, \frac{a}{D}, \frac{v^2}{gD}, \theta\right) \tag{18}$$

and it is also known that the flow is in the turbulent range, so that

$$F_1\left(\frac{\rho v D}{\mu}\right) = A\left(\frac{\rho v D}{\mu}\right)^{-0.25} \tag{19}$$

then δ may be computed:

$$\delta = (H/a)/(H_m/a_m) \tag{20}$$

$$= \frac{F_2\,(d/D\,,\ a/D\,,\ v^2/gD\,,\ \theta)}{F_2\,(d_m/D_m\,,\ a_m/D_m\,,\ v_m^2/g_m D_m\,,\ \theta_m)} \times \frac{A\,(\rho v D/\mu)^{-0.25}}{A\,(\rho_m v_m D_m/\mu_m)^{-0.25}} \tag{21}$$

$$= \frac{(\rho v D/\mu)^{-0.25}}{(\rho_m v_m D_m/\mu_m)^{-0.25}} \tag{22}$$

$$= 1/\alpha^{-0.25} = \alpha^{0.25} \tag{23}$$

In this example, it is evident that the second function will cancel in Eq. (21) if the design conditions of Eq. (8), (9), (11) and (13) are satisfied.

In other words, the effect of the distortion may be evaluated even though detailed knowledge of the function in Eq. (7) is not available. It is sufficient to know that the effect of the variable $\rho vD/\mu$ is independent of the effects of the other variables or, in mathematical, terms that the function F in Eq. (7) is separable into two functions F_1 and F_2 as indicated in Eq. (18).

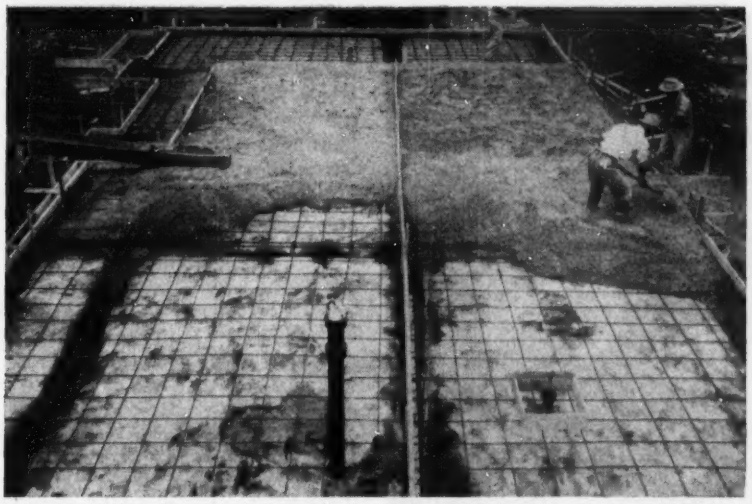
Whether or not the function is separable within the operating range of the prototype may be known from the nature of the phenomenon or, if not it may be determined by running sets of experiments on the model.

Test for Separation of Variables

A test for determining whether or not a function

$$\pi_1 = F(\pi_2, \pi_3, \pi_4, \ldots, \pi_n) \tag{2}$$

may be expressed as a product of two functions



FULL SCALE unit. Stress analysis on model pinpoints exactly where members go.

$$\pi_1 = F_1(\pi_2)\, F_2(\pi_3, \pi_4 \ldots . \pi_n) \quad (24)$$

is conducted by developing a curve for π_1 vs. π_2 with the other Pi terms held constant. This makes F_2 (π_3, π_4 . . . . π_n) constant and

$$\pi_{1a} = C_a F_1(\pi_2) \quad (25)$$

Then a second curve is developed for π_1 vs. π_2 with the other Pi terms again held constant, but at different values from those used before. In this series F_2 (π_3, π_4, ... π_n) will again be constant, but will usually have a different numerical value, hence

$$\pi_{1b} = C_b F_1(\pi_2) \quad (26)$$

If Eq. (25) is divided by Eq. (26) there results

$$\frac{\pi_{1a}}{\pi_{1b}} = \frac{C_a F_1(\pi_2)}{C_b F_1(\pi_2)} = C_a/C_b \quad (27)$$

Thus, if the ratio of the two equations for π_1 is a constant the variable π_2 is separable as indicated in Eq. (24). If the ratio is not a constant, the function F in Eq. (2) cannot be replaced by the product of the two functions in Eq. (24). In the latter instance, it may be possible to separate one or more of the other Pi terms from the function.

Frequently the component curves, such as those indicated by Eq. (25) and (26), plot as straight lines on log paper. If they do, the test for combination by multiplication is equivalent to indicating that the two straight lines be parallel.

The two series of tests outlined also give the pertinent information for the analytical determination of the effect of the distortion upon the prediction factor δ. If the data satisfy the test for combination by multiplication δ will be a function of the distortion α only, and if the data fail the test, the prediction factor will be a function of at least one of the Pi terms as well as the distortion α.

Similar tests may be devised for other methods of combination of functions. For example, if it is found that F_{1a} *and* F_{1b} differ by a constant numerical value, the function F_{1a} and the function F_{1b} are to be added together instead of being multiplied.

Multiple and Compensated Distortion

It is frequently necessary, or desirable, to distort more than one factor in the model. In this situation the evaluation of the prediction factor is no different fundamentally than when only one factor is distorted. The procedures outlined may be repeated step by step for each of the terms.

In certain applications it may be desirable to distort two of the terms so that the distortion of one compensates for the distortion of behavior of the other. For example, in models of rivers, the depth is usually distorted to eliminate the distortion resulting from the increased importance that surface tension would have if the depth were reduced in the same ratio as the width of the stream. The distortion involved in increasing the depth increases the velocity to an undesirable degree; so the roughness is increased to compensate for the depth distortion.

Applications to Chemical Engineering

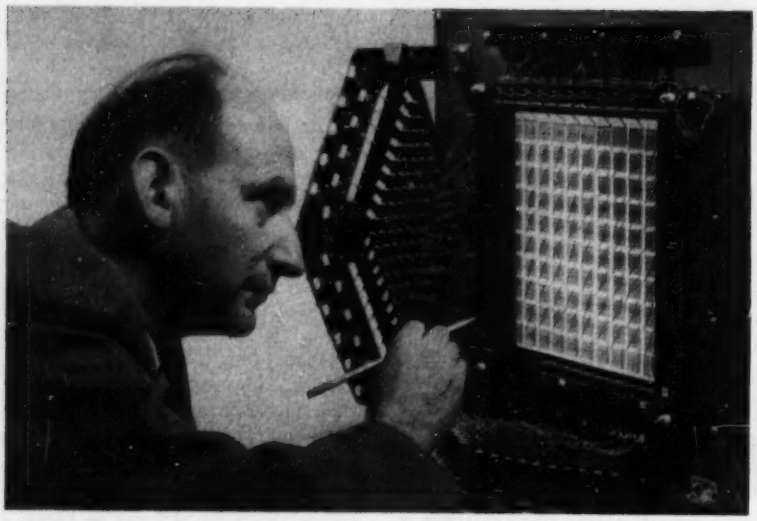
The principles outlined in the foregoing example may be applied directly to a variety of chemical engineering problems. Each application requires careful analysis to be certain that none of the pertinent variables are omitted. For example, if the quantity g is omitted from the list of variables in Eq. (6) the results obtained from the model tests may be extremely misleading. However, if H is replaced by a pressure difference, g is not necessary. Points of this type may be established by theory. Or if theory is lacking, by using two models of different size or operating one model under a variety of conditions. Information on the relative importance of various terms may also be obtained from model tests.

In general, the problem of predicting the effect of scaling up the results obtained from a pilot plant may be resolved into a series of component problems—each involving a basic process of which the following are examples:

1. Fundamental reactions
2. Materials transportation
3. Size reduction
4. Mechanical separation
5. Mixing
6. Evaporation
7. Drying
8. Crystallization
9. Heat transfer
10. Mass transfer

It is usually advantageous to study separately the effect of the degree of distortion contemplated for each process but this cannot always be done. For example, the yield of a given step in a process may be dependent on the rate of the fundamental reaction, which is in turn dependent upon the heat transfer and mass transfer rates as well as the system's geometry.

Distortion will be involved in the majority of the operations indicated when the length scale is changed. In materials transportation size reduction, mechanical separation and mixing, gravitational forces and inertia forces are involved. If the model is to be undistorted, both the velocity scale and the time scale must be equal to the square root of the length scale.



ELECTRICAL ANALOG machines are proving to be valuable tools in the solving of complex chemical and mathematical problems.

As the length scale is increased, the relative importances of the various forces involved should remain the same to avoid distortion. Frequently it is impossible to prevent one force from changing in relative importance. For example, in a model involving the handling of small particles, electrostatic charges on the particles may assume an importance entirely out of proportion to their significance in the prototype.

However disturbing these effects may appear to be at the outset, they will be taken into account automatically by the methods outlined.

Analogies

In one sense an analog is a type of model. That is, it is a system from which data are taken to assist in predicting the behavior of another system — the prototype. However, an analog differs from a conventional model in that the latter usually resembles the prototype in general configuration although it may be larger or smaller than the prototype and some elements may be distorted. In contrast, the analog usually bears no physical resemblance to the prototype. The prototype may be a mechanical system and the model (or analog) may be electrical in nature. However, it faithfully reproduces significant prototype characteristics.

A distinction must be made between an analog and a computing machine. Information taken from the analog at any stage of operation is directly related to a corresponding item in the prototype at a corresponding time. Information taken from a computing machine at an intermediate stage in the solution of a problem is not necessarily related to an event in the prototype. The final result from the computing machine may faithfully represent the corresponding final event in the prototype, but that result may be obtained by a series of processes entirely different from the steps by which the result is attained in the prototype. In an analog system the steps correspond in detail.

General Theory

An analogy exists between two systems when the characteristic equations for the system are identical and when one set of conditions correspond. It has been pointed out that a characteristic equation exists for a given phenomenon in the prototype. The equation may be written in general terms as

$$\pi_1 = F(\pi_2, \pi_3, \pi_4, \ldots . \pi_n) \qquad (28)$$

In another system the characteristic equation may be

$$\pi_{1m} = F_m(\pi_{2m}, \pi_{3m}, \pi_{4m}, \ldots . \pi_{nm}) \qquad (29)$$

If there are the same number of Pi terms in each system and if the form F_m is identical to the form of F an analogy can exist between the two systems. For the model to give information from which the action of the prototype may be predicted it is apparent that the following design conditions must exist

$$\begin{aligned} \pi_{2m} &= \pi_2 \\ \pi_{3m} &= \pi_3 \\ \pi_{4m} &= \pi_4 \\ &\cdots \\ \pi_{nm} &= \pi_n \end{aligned} \qquad (30)$$

If these are satisfied, the prediction equation becomes

$$\pi_1 = \pi_{1m} \qquad (31)$$

The design and prediction equations for the analogy are identical with those indicated for the conventional model. The difference between the analogy and the conventional model is that, in the conventional model the form of the functions F and F_m may not be known but care is taken to make them identical by having them represent identical phenomena. In the analogy the form of F and F_m must be known to be identical but the phenomena that they represent are not the same.

For example, π_2 might be a term involving pressure differential while π_{2m} was a term representing voltage. In fact, even though the number of Pi terms is the same in model and prototype the number of initial variables may be different in the two systems.

To establish an analogy that will be useful in predicting the behavior of a prototype the characteristic equation governing the basic operation of the prototype must be known. This may be a simple algebraic equation, or it may be a complex differential equation for which no known solution exists. Next, another system having the same characteristic equation must be found. If such can be found the detailed design of the analog system follows by applying the design equations given as Eq. (30) above.

How It Works

The characteristic equation for the two-dimensional irrotational flow of an incompressible fluid may be written as

$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = 0 \qquad (32)$$

in which x and y are coordinates and ϕ is the velocity potential.

The components of velocity u and v in the x and y direction respectively may be found from the velocity potential as

$$u = \partial\phi/\partial x \quad (33)$$

$$v = \partial\phi/\partial y \quad (34)$$

The characteristic equation for the flow of current in a homogeneous plane conductor is

$$\frac{\partial^2 \phi_m}{\partial x_m^2} + \frac{\partial^2 \phi_m}{\partial y_m^2} = 0 \quad (35)$$

in which x_m and y_m are coordinates. The term ϕ_m, is the current potential from which the components of current may be found

$$i_x = \partial \phi_m/\partial x_m \quad (36)$$

$$i_y = \partial \phi_m/\partial y_m \quad (37)$$

From the similarity of Eq. (32 and 35) it is evident that an analogy exists between two-dimensional irrotational fluid flow and the flow of current in a homogeneous plane conductor.

If an analogy is to set up, it is convenient to assume that coordinates in the model correspond to the coordinates in the prototype. Thus

$$x = n\, x_m \quad (38)$$

$$y = n\, y_m \quad (39)$$

It may also be assumed that

$$\phi = n_1\, \phi_m \quad (40)$$

If these conditions are satisfied, it follows that

$$u = \left(\frac{n_1}{n}\right) i_x \quad (41)$$

$$v = \left(\frac{n_1}{n}\right) i_y \quad (42)$$

Thus a model of fluid flow system may be constructed using an electrical field that is geometrically similar, but not necessarily identical in size to the fluid flow system. Voltages are applied at points corresponding to the points of entrance and exit of the fluid and the current measured. Actually, it is usually more convenient to measure voltage drops to various points in the system. From the observations on the model and Eq. (41) and (42) the components of velocity in the fluid flow system may be evaluated.

Lines of constant voltage in the electrical system are everywhere perpendicular to the lines of constant ϕ_m and are known as equipotential lines. They may be designated as lines of constant ψ_m. The equipotential lines in the electrical system correspond to lines of equal pressure in the fluid flow system. The lines of equal pressure (constant ψ) are everywhere perpendicular to the lines of constant ϕ.

Laplace Equation Systems

The equation indicated for the fluid flow system, Eq. (32) and the equation for the electrical field, Eq. (35) are known as Laplace equations. Several physical systems have characteristic equations of this form, as shown in Table I.

Poisson Equation Systems

The Poisson equation, which is the characteristic equation for several physical systems, is

$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = -C \quad (43)$$

In each system x and y are coordinates. The quantities $\partial\phi/\partial x$ and C have the meanings indicated in Table II.

Other Systems

The foregoing sets are given as illustrations of a few of the more common analogous systems. Many different pairs of analogous systems have been cited and a number have been investigated experimentally. A complete list of analogies is too lengthy to reproduce here, but recent applications of particular interest to the chemical engineer include an analogy between the one-dimensional diffusion of a solute in a solvent and the heat flow along a rod, and the analogy between heat transfer and mass transfer. The latter has been the subject of several recent articles and discussions.

Analogies are useful tools, but like other tools, they must be properly used to produce satisfactory results. A common error is the failure to establish completely the validity of the analogy. This must be done by rigorously demonstrating that the characteristic equations for the two systems are actually identical in form and not merely somewhat similar.

Unless the equations are identical in form the analog will be distorted and the prediction factor must be evaluated before the behavior of the prototype can be predicted from observations on the model. When properly used, analogies can save a vast amount of labor in the solution of complex problems.

Table II–Systems Satisfying Poisson Equation

System	$\frac{\partial\phi}{\partial x}$	C
Torsional stress..	Torsional stress....	$\frac{2G\theta}{L}$ = 2 (modulus of rigidity) × (angle of twist) / Length of shaft
Membrane.....	Slope of membrane.	$\frac{P}{S}$ = Pressure differential on two sides of membrane / Surface tension
Rotating fluid....	Slope of surface....	$2\omega = 2$ (Angular velocity)
Velocity distribution of fluid flow in pipe	Velocity gradient...	$\frac{k}{\mu}$ = slope of pressure gradient / viscosity

Table I–Systems Satisfying Laplace Equation

Phenomenon	Lines of constant ϕ give directions of	Lines of constant Ψ give constant values of
Fluid flow.....	Resultant velocit.....	Pressure
Electrical field.....	Resultant current.....	Voltage
Heat flow.....	Resultant heat flow.....	Temperature

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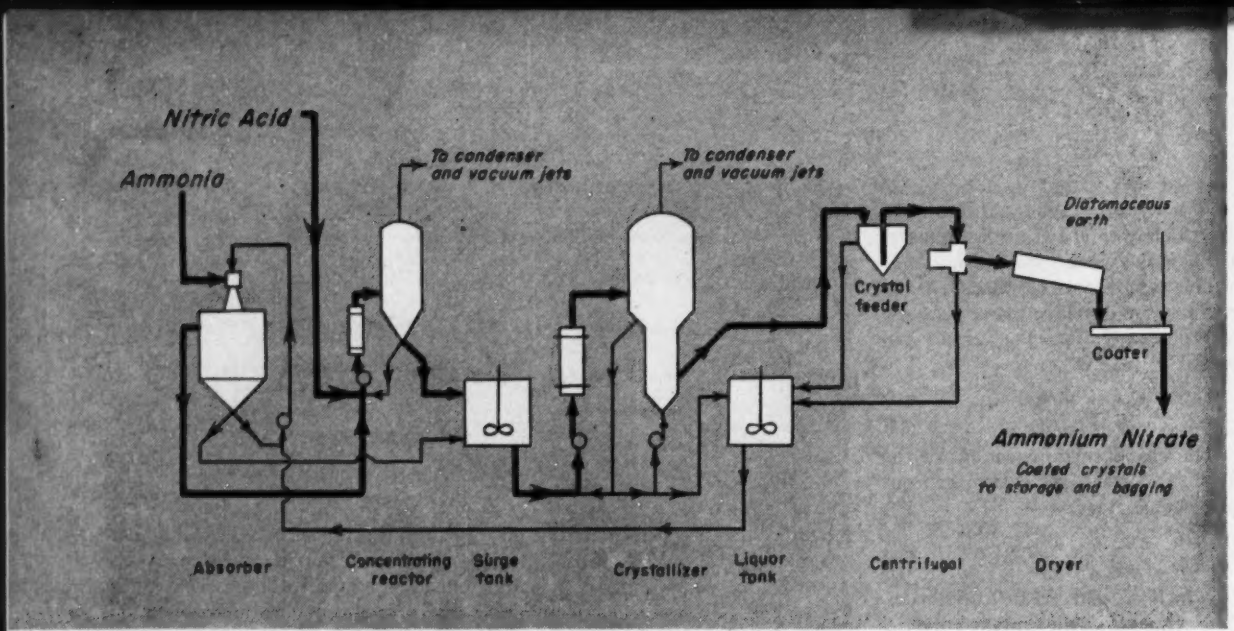


New Process for Ammonium Nitrate

H. G. FELIO, Singmaster & Breyer, New York, and CHARLES OWEN BROWN, Consultant, New York

Ammonium nitrate is now being made by the novel two-stage crystallization process shown in the flowsheet above. This is the final operation in the plant of Aburdarverksmidjan H. F., near Reykjavik—Iceland's first venture into chemical manufacturing.

Raw materials available are air, very cold water and low-cost power. Starting with these, the plant makes electrolytic hydrogen, nitrogen from air liquefaction, ammonia, nitric acid and ammonium nitrate. While this plant is not large (30 tons per day of ammonia), cost factors will permit any surplus product to be competitive on the world market.

▶ **Hydrogen**—A.c. power is converted to two d.c. circuits of 15,000 amp. at 405 v. Each circuit feeds a loop cell bank of 192 hydrogen cells. Hydrogen is scrubbed, cooled and fed into a gas holder.

▶ **Nitrogen**—Air is compressed to 27 atm. by a 250-hp., three-stage compressor, cooled, scrubbed with caustic and dried by freezing out the water in reversible heat exchangers. It is liquefied in another heat exchanger and expansion engine, then fractionated in a double distillation column.

▶ **Ammonia**—Nitrogen and hydrogen, in a 1:3 ratio, are put through a palladium catalyst to remove any traces of oxygen, then go to two 700-hp., five-cylinder compressors. The mixed gas is compressed to 5,150 psi. and fed through filters (for oil removal) to the synthesis loop. Here the gas circulates through circulator compressors to the secondary water-cooled condenser, secondary separator, heat exchanger and converter. From the converter the gas goes through the main heat exchanger, primary condenser and primary separator, then back to the circulating compressors. Ammonia is continuously bled off at the separators and transferred to weigh tanks and storage.

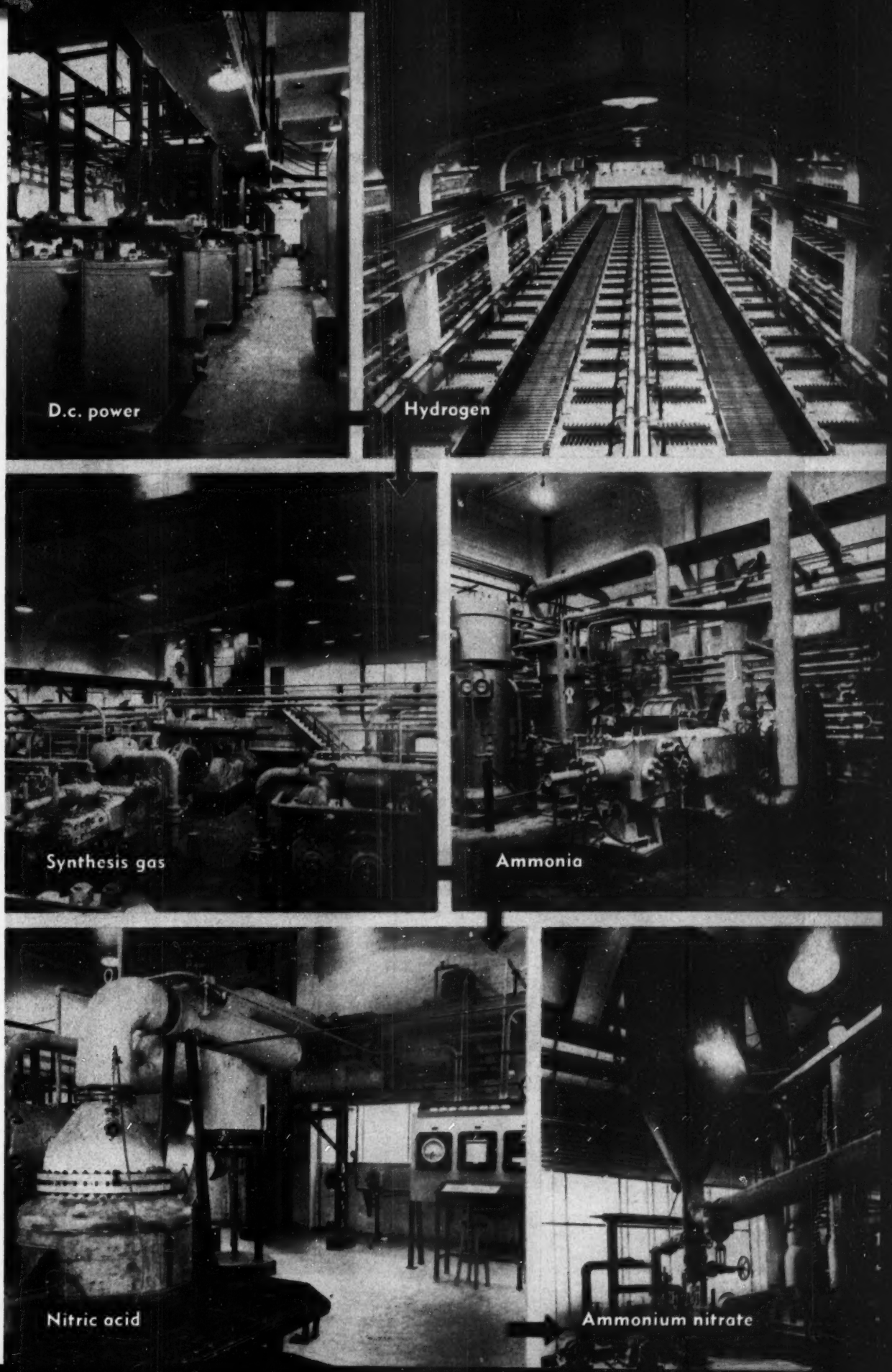
▶ **Nitric Acid**—Air from an 800-hp., two-stage compressor goes through a heat exchanger to the air-ammonia mixer, where ammonia vapor is added in a controlled ratio. The mixture goes through a filter to the converter. Hot gas (containing nitrogen oxides) from the converter passes through a waste-heat boiler, producing about 6,000 lb. per hr. of 250-psi. steam, and then in succession through the heat exchanger, condenser, oxidation chamber, absorption tower and drums to the bleacher, finally to storage as 60% nitric acid.

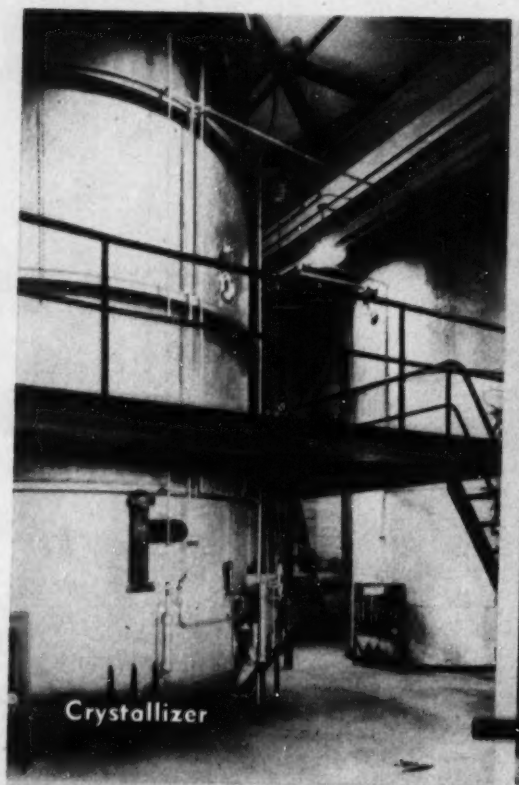
▶ **Ammonium Nitrate**—The plant was designed to produce a relatively uniform and dust-free crystalline product via a process in which all temperatures and liquor concentrations are held at moderate levels which avoid hazards.

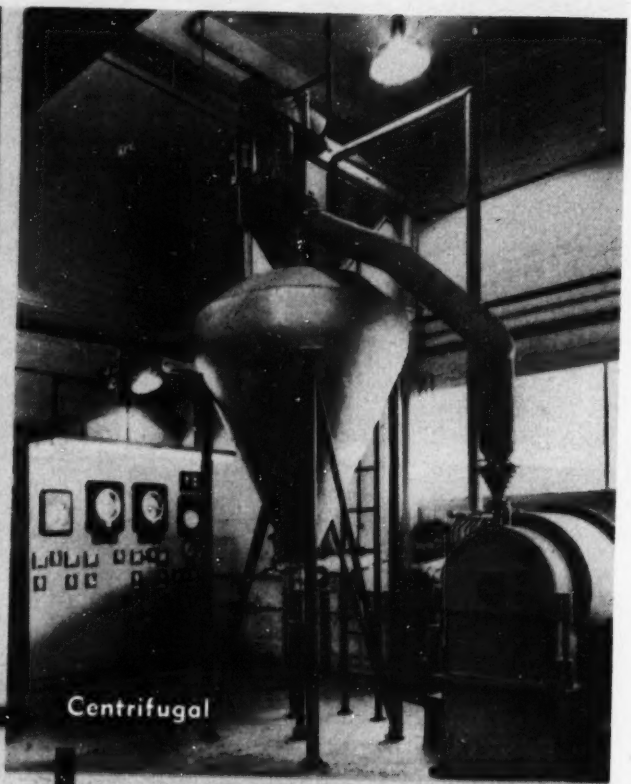
In the circulating loop of a vacuum concentrator (see *flowsheet*) nitric acid is reacted with ammonia dissolved in recirculated mother liquor from the crystallizer. The reaction provides enough heat to evaporate all water introduced by the 60% nitric acid; evaporation is divided between concentrator and crystallizer. Liquor containing the reaction product passes through a surge tank, in which any slight amount of free acid is neutralized, and is then fed to the crystallizer as a warm unsaturated solution at about 125 F.

In the crystallizer this solution is cooled under vacuum to a lower temperature (about 97 F.) to effect crystallization of form III ammonium nitrate crystals. (This crystal form is relatively stable during drying.) Classified product is discharged in a stream of liquor to a conical crystal feeder and centrifugal. Undersized crystals are retained in process for further growth while mother liquor is recycled, first to the ammonia absorber and then to the concentrating reactor, to complete the cycle.

The centrifuged crystals pass through a rotary dryer, then are coated with diatomaceous earth. The coated crystalline product contains over 33% nitrogen.


D.c. power
Hydrogen
Synthesis gas
Ammonia
Nitric acid
Ammonium nitrate


Crystallizer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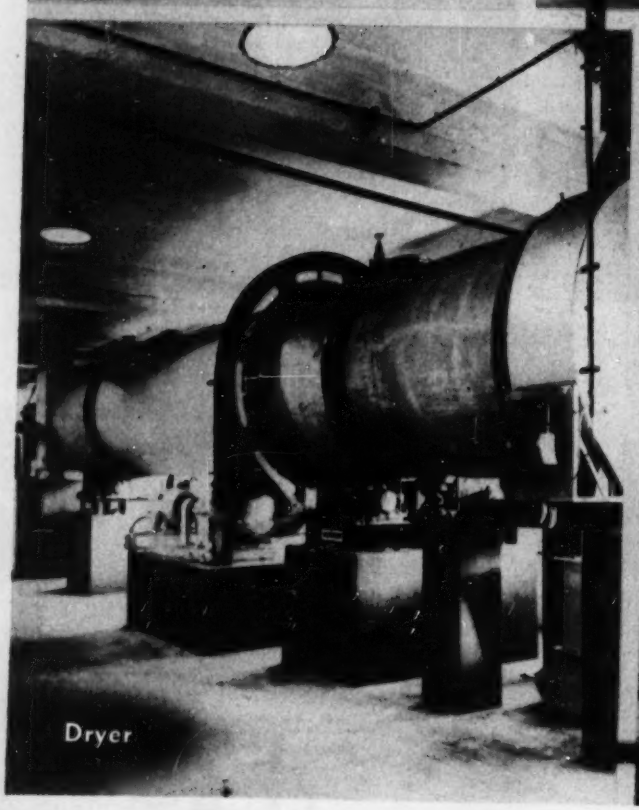
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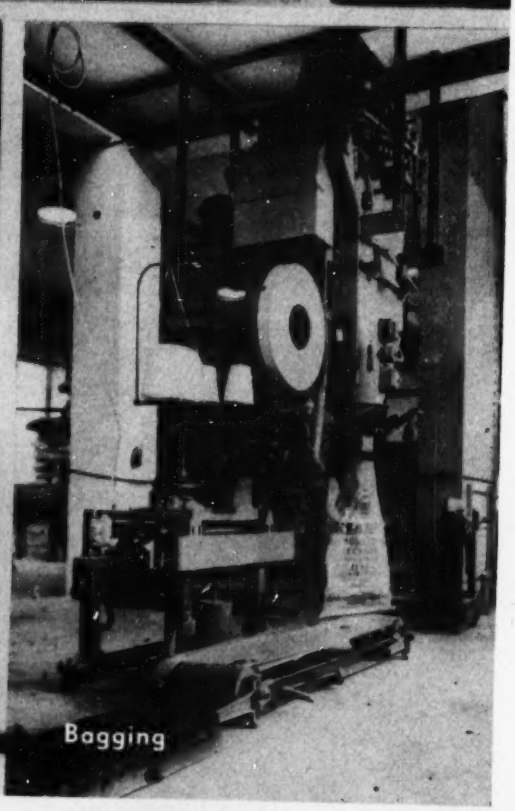

Bagging

Breakdown vs. Preventive Maintenance

Usually the preventive approach is the less costly—but there are circumstances under which it pays to let your equipment run until it breaks down before making the necessary repairs.

O. W. GRAVELEY

Experience, backed by adequate records of past performance, can be made the basis for individual decisions as to where to draw the line between preventive maintenance and making repairs as the occasion demands.

But psychology and the meaning of words may be affecting our thinking when coupled with "preventive maintenance" and "breakdown repairs." For some years many of those associated with plant upkeep have been following the path of "prevention," while others have followed the older and less complex method of "breakdown."

Some reasons must exist for these divided ways. Thought association with the word "breakdown" can bring to mind unpleasant pictures of circumstances in connection with the factory, home or auto, while no such unpleasant thoughts are suggested by the word "preventive." Are we pursuing feelings or facts? Let's examine some of the factors involved.

Basis for Comparison

Comparisons require a basis and, for this reason, it will be a good idea to refer to the comparison table on the next page. Note that breakdown repairs require little planning except to provide labor and spare parts, while preventive maintenance is a completely planned procedure.

When Breakdown May Be Best

Where experience shows that certain emergency repairs do not reduce production or increase over-all costs of maintaining equipment, it may be that such repairs can be best handled as the actual need demands.

However, this can only be done economically if a substantial part of the total repair labor requirements are planned. Otherwise, since it is obvious that actual breakdowns cannot be predicted, a higher-than-needed labor force must be maintained to meet extreme conditions—or else excessive overtime premiums and lower labor efficiencies will inevitably result to meet the peaks in demand.

Where Preventive Maintenance Paid Off

Coke Drying System

	Breakdown Basis	Preventive Basis
Output, Tons/mo. →	65,000	100,000
Repair Cost, $/mo. →	2,000	1,600

Based on actual experience

A physical failure, such as a furnace burn-through or loss of bricks in a lime kiln, involves large pieces of equipment with long cool-down periods. These cool-down periods would be the same for inspection as for repairs and under the circumstances the economics are in favor of "breakdown repairs."

In Favor of Preventive

There can be no denying that a plant which operates on breakdown repairs has a greater incidence of deferred maintenance than one operating on a preventive maintenance plan.

Again, arguing for preventive maintenance, let me remind you that a prudent man will not start on a long motor trip without first having his car checked and serviced to insure, as far as possible, against accidents and operating failures. This same logic applies to all mechanical equipment regardless of location. The cost is small when compared with the penalties for neglect.

Preventive maintenance requires trained personnel, constant attention, established routines and records. These have a way of increasing beyond need unless checked occasionally and should be kept to a minimum.

The example of the coke drying system on this page is exceptional, but indicative of the results that can be obtained by careful planning. This is especially true where multiple units form a manufacturing system, and down time to a single unit interrupts production. With preventive maintenance the repairs to all units requiring attention are made during a single production shutdown, while with breakdown repairs an interruption is required for each job on a unit.

Preventive maintenance, when set up properly, can use tabulating machines to analyze data. At present we are using them for analysis of the following:

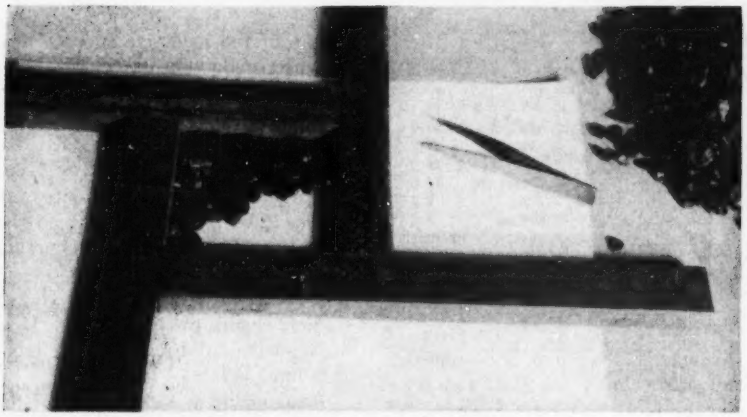
1. Report of completed orders monthly, by charge and by department including estimate of work by hours, actual performance by hours, variation between estimated and actual in hours, and actual expenditures for labor in dollars.
2. Report on dollars and hours expended in each department, by craft and job, monthly.
3. Backlog of work by department and job, weekly.
4. Backlog of work by craft, weekly.
5. Report on jobs other than regular repairs, which contains all information the same as prepared for regular repair jobs, monthly.

We are continuing with the development of the use of tabulating machines for data analysis and shall eventually obtain all our information from this source.

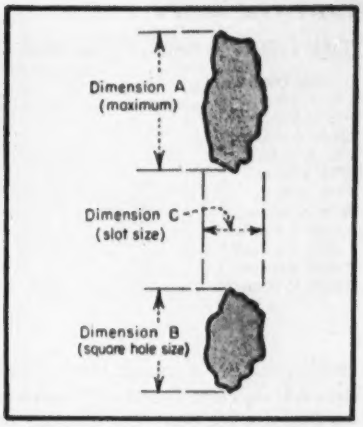
O. W. GRAVELEY *is works engineer, Electro Metallurgical Co., Division of Union Carbide and Carbon Co., Niagara Falls, N. Y.* *This article is based on his talk before the Plant Maintenance and Engineering Conference, held concurrently with the Plant Maintenance and Engineering Show, Chicago, Jan. 25-28, 1954.*

Basis for Comparison of Breakdown vs. Preventive Maintenance

	Breakdown	Preventive
Maintenance Personnel	Supervision adequate for the number of men. This will vary, according to craft and location, from 1 in 8 to 1 in 30. Mechanics of sufficient number to be on hand for breakdowns, either in the shops or to be removed from jobs already started. No job training program to guarantee skill or number of mechanics required. Clerical help to handle phone or messenger delivered job orders, keep location of men and check time cards.	A maintenance department head with sufficient number of foremen to adequately supervise work based on location and craft, varying from 1 foreman for 8 hourly men to 1 foreman for 30 men, with an average of approximately 16. Hourly men with sufficient skill or ability to perform the work, backed up with a training program for present and future requirements. A preventive maintenance program administrator, with clerks for scheduling, expediting and recording. Duties of this group include development and establishment of procedure, work with maintenance and operating foreman to establish inspection and lubrication schedules, assist in the formation of maintenance department weekly schedules, supervise procedures in maintenance department relative to program, collect and transfer information between master mechanic and department foreman, check and maintain proper repair order charges, work with department foreman to set up spare parts carried in stores, maintain equipment inspection and service records, coordinate and follow up maintenance cost control, direct the sending out of "tickler sheets" and check on their return, check effectiveness of maintenance program and recommend procedure changes, perform other miscellaneous work in conjunction with the maintenance program such as tabulation of work backlog, records of maintenance, planning and cost analysis.
Maintenance Records	Repair costs by job, sub-totaled by the month and totaled by the year, to inform departments of costs and to be used for budget purposes. Some data on equipment that show the need for immediate repair.	For planning, a good set of records is required. These records should include manning table to show the standard crew required for the average of work to be done, backlog of work history to show whether an increase or decrease of crew is required, work distribution to show where concentration is required, overtime requirements to determine whether emergencies are occurring too frequently, equipment record cards bearing as a file number the cost department's repair order equipment charge number. The information on these cards consists of equipment title, maker, date of purchase and purchase order number, serial number, motor requirements, starting equipment, use of equipment, spare parts carried, lubrication and intervals, inspection and intervals, when inspections are made and condition by symbol, repair order data as and when completed. This information is placed on cards in a book, made up for each operating department, which includes each major piece of equipment in that department. A copy of this information is also in the maintenance department.
Spare Parts	Work done on equipment is used to predict future spare part needs. Large stores required since equipment condition is not well known.	A survey is made of spare part requirements concurrently with setting up of equipment data cards. Periodic reviews must be made, based on parts delivery changing, use differing, or other influencing factors occurring.
Inspection Procedures	Regularly scheduled inspections on critical electrical equipment, none on buildings or general equipment.	Equipment inspections are made by Class A craftsmen, who ordinarily repair the type equipment involved. These craftsmen use check lists. A copy of the check list, showing the current equipment conditions and recommendation for repairs, is given to the foreman of the operating department and to the maintenance department. Equipment inspections are made on a time or use basis, whichever comes first. Time intervals were set up for inspection of equipment during the earlier equipment investigation to determine condition and use. These intervals vary to meet equipment needs. The use basis was also set up at the time of the original equipment investigation and is reviewed as use changes. Time intervals for inspections are set up on tickler sheets sent out by the maintenance department. These tickler sheets are reminders to department foremen and the maintenance department that inspections, major repairs, overhauls and other known conditions require attention as indicated.
Job Scheduling	Done hourly as repair orders are received, often requiring much reassignment of men during the same day. A major part of the time of all maintenance supervision is required to allocate men and equipment.	All work other than emergencies is planned by scheduling on a weekly basis. The week runs from Monday to Friday inclusive and the scheduling is done on Friday for the following week. Emergencies will occur which require the use of men shown on the weekly schedule. To meet this requirement, jobs of secondary importance, from a time standpoint, are included in the schedules. Men may be removed from these secondary jobs without seriously affecting plant operations. Those jobs from which men have been removed for emergencies are re-scheduled the following week. The scheduling is done by the craft foreman involved and a member of the master mechanic's staff. To do this scheduling it is necessary that the man-hour requirement of each job be known. To obtain this information, foremen estimate the man hours from past performance.
Cost Control	Report on final cost of job some time after completion. Little, if any, advance estimating.	Each major item of equipment and building must have its own repair order charge number to allow an accurate check of repair costs on individual items. Accurate historical data simplify the problem of budgeting, allow careful consideration when equipment replacements and changes are needed, and point up maintenance department failures and operating department equipment abuses. When the repair order is used as a basis for cost records, it is written for one repair and one piece of equipment only. Costs accumulated on this basis will also give nature and frequency of repair for future study and action.
Lubrication	No over-all program; each department gets along as best it can.	Complete schedules of lubrication are prepared under supervision of the maintenance control administrator for each item of equipment. These schedules are in the operating and maintenance departments. Motors and cranes are taken care of by the maintenance department. Other equipment is lubricated either by the maintenance department or the operating department, as set by the operating department.
Coordination With Operating Departments	Operating departments report breakdowns and write repair orders. Heads of these departments spend a good deal of their time trying to get maintenance done. They are required to know equipment condition in detail and advise the maintenance department of work required.	Preventive maintenance requires the cooperation of operating departments. Equipment must be made available for inspection or repair on schedule, if operations permit. Operators must be notified in advance if the maintenance department cannot keep its schedule. The operating department foreman takes part in all planning and scheduling in his department.



BLOCK method for finding the shape factor and Dimension A.



DIMENSIONS which characterize shape.

Control Particle Shape and Size

. . . in your grinding operations. Here are some tips, from an expert in the field, on how to measure particle shapes and how to modify size-reduction operations to get the shape and size you want.

FRED C. BOND

Products of crushing and grinding operations vary widely in particle shape and size distribution. It's frequently important—and often difficult—to measure these variations in a going operation or to predict them for a proposed installation.

Two factors—nature of the material being reduced, and type and operation of the machine used—control particle shape and size distribution of the product. In this article we shall study and evaluate these factors in order to gain a better understanding of size-reduction operations.

How to Characterize Particle Shape

Ideal particle shape of a crushed or ground product is equidimensional —either cubical or spherical. For concrete aggregate or road stone we prefer a cubical product. For particles used in abrasive cutting we want sharp-cornered cubical shapes.

Since dimension measurements of stone particles are difficult, we sometimes use visual comparison as a measure of cubicity. Actual measurements, however, are preferable.

Let's define A as the longest dimension of a given particle. B is the longest dimension at right angles to A, and C is the longest dimension at right angles to both A and B.

The ratio $A{:}B{:}C$, therefore, expresses the relative particle shape. When the value of B is 1.0, A averages about 1.3 and C about 0.6. When A is greater than 2.0 the material is acicular, or needle-like; when C is 0.4 or less the material is tabular or slabby. We can call A the elongation factor and C the slabbing factor.

How to Measure Particle Dimensions

Dimension B is measured exactly by the diameter of the round hole the particle will just pass and approximately by the square hole. Dimension C is measured by the width of the slotted opening it will just pass.

To evaluate C for each sieve size when B is 1.0, we first run a screen analysis of the sample on square-hole sieves in the $2^{0.5}$ standard screen scale. Then we recombine the fractions and run an analysis on a series of slotted openings equal in width to the square openings of the screen scale. Slot length should be at least three times slot width.

We plot both screen analyses on the same graph sheet; ordinate is the percent passing, on a logarithmic scale, and abscissa is the screen size, at equal unit intervals. Horizontal distance between the two plotted analyses will be about one unit screen interval. We measure this distance n for each sieve size and from it calculate the value of C:

$$\log C = -0.1505n \qquad (1)$$

Dimension A is more difficult to evaluate, since we know of no satisfactory method using screen analyses. We can use either of two indirect methods—the block method or the weight method. Both involve counting particles of each sieve size.

How to Use the Block Method

We screen the sample on the standard $2^{0.5}$ sieve series and test each size fraction separately. To do this we place particles of one size fraction on their flattest side and pack them together as closely as possible, without

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Table I–Data for Setting Up the Block Method

Size Fraction	Diameter *b*	Volume *V*	Length *L*
3 in. × 2 in.	64.36	139.56	60.0
2 in. × 1½ in.	45.52	49.385	42.4
1½ in. × 1 in.	32.18	17.450	30.0
1 in. × ¾ in.	22.76	6.174	21.2
¾ in. × ½ in.	16.09	2.182	15.0
½ in. × ¾ in.	11.376	0.7709	10.6
¾ in. × 3 mesh	8.052	0.2733	7.5
3 mesh × 4 mesh	5.694	0.09665	5.3
4 mesh × 6 mesh	4.026	0.034175	3.75
6 mesh × 8 mesh	2.847	0.012085	2.65
8 mesh × 10 mesh	2.013	0.004270	1.875

overlapping, in a square block of an area calculated to contain 100 spheres of this size fraction. The number of particles actually contained in the block divided by 100 is the value of A.

Here's a way to do this faster and more accurately: We graduate four metal bars with the dimensions *L* of Table I, beginning at one end of each bar, and mark the graduations with their corresponding mesh sizes. We arrange the bars to form a square enclosing the exact area which would contain 100 circles of each of the graduated screen sizes, as shown in the illustration on the preceding page.

(In Table I *b* is the diameter in mm. of the average particle of the size fraction, V is the volume in cc. of a sphere of diameter *b* and *L* is the length in cm. of the side of a square which will contain 100 circles of diameter *b*.)

How to Use the Weight Method

We can also get dimension A by weighing and counting a number of particles of a single mesh size *b* and finding the average particle weight, provided we can make a reasonable assumption regarding the shape factor.

This shape factor *f* is a measure of the variation of the effective particle shape from that of an ideal ellipsoid with axes *A*, *B* and *C*. When *B* is 1.0, *f* for the ideal ellipsoid is 1.0. When *f* is less than 1.0 the volume of the particle is less than that of the A:1.0:C ellipsoid; when *f* is greater than 1.0 the volume is more than that of the ideal ellipsoid. A low value of *f* indicates a tendency to form irregular sharp corners and angles.

We can calculate *f* from this equation:

$$f = w/SVAC \qquad (2)$$

where w is the average particle weight in grams, S is the specific gravity and V is the volume in cc. of a sphere of diameter *b*. We find C by screening on square holes and slots and get A by the block method.

Having once found *f* for a particular type of material, we can use this value for determining A by the weight method, merely by solving Eq. (2) for A. This avoids the laborious block method.

Measurements made to date indicate that *f* is fairly consistent for different samples of the same type of material. Table III reports measurements of *C*, *A* and *f* on the seven materials identified in Table II. There were seven size fractions of each material. Dimension A was found by the block method and *f* calculated from Eq. (2).

Average value of the slabbing factor C for all sizes in Table III is 0.581, and average elongation factor A is 1.234. The value of *C* is fairly constant for all the screen sizes tested, while the value of A increases with the finer sizes.

Average shape factor is 0.846. It is about the same for both large and small particles, although different materials show different trends. Coal particles tend to have smaller shape factors at the finer sizes. The composite average indicates that the volume of the average particle is about 15 percent less than that of its equivalent A:1.0:C ellipsoid.

We can use these methods to measure the cubicity of crusher products, getting direct numerical comparisons of the particle shapes of different materials, as well as the effects of different types of machines and processes upon particle shape.

How Can We Control Particle Shape?

Character of the material being broken has more influence on shape of the product particles than the type of reduction machine used or the nature of the reduction process. For instance, reduction of mica always produces thin, tabular particles, no matter what type of machine or process. A laminated or bedded material always tends to produce slabs, and monoclinic crystals tend to produce acicular particles, while isometric crystals tend to produce more cubical particles.

However, we can modify product particle shapes to some extent. Here are some conditions which make products more cubical:

Breaking by impact rather than by attrition; increasing the impact velocity; increasing the number of reduction stages and reducing the reduction ratio of each stage; direct breaking between metal surfaces rather than cushioned breaking between particles of material; breaking by direct blows rather than by glancing blows; breaking across individual grains rather than along grain boundaries; keeping moisture content low in dry reduction processes; and using media of high specific gravity in grinding mills.

How Machine Action Affects Shape

The most important single condition for increasing cubicity of product is high impact velocity. Machines like the hammer mill or pulverator have the highest impact velocities of any of the commonly used reduction machines; their products are usually quite cubical. However, cubicity may be reduced by glancing blows, high moisture content or high reduction ratios. Use of grate bars in hammer mills increases the number of glancing shearing blows and tends to reduce cubicity.

With jaw, gyratory and cone crushers we can increase cubicity of the products by increasing the speed. Increasing the length of stroke has the opposite effect; even though it increases crushing velocity at the cen-

Table II–Materials Whose Dimensions Are Reported in Table III

Material	Location	Specific Gravity
Coal I	Keller, Ind.	1.345
Coal II	Piatt, Ill.	1.345
Coal III	Bluefield, W. Va.	1.270
Lead ore	Hailey, Ida.	3.39
Burned flint clay	Muncie, Ind.	2.73
Nepheline syenite	Ontario, Canada	2.67
Quartzite	Ocoee, Tenn.	2.65

ter of the stroke, it often allows oversize slabs to discharge, increases the cushioned crushing of material against itself and increases the packing of fines in the crusher to form packed slabs, or "pancakes."

Crushing surfaces with matched corrugations usually form a more cubical product than smooth surfaces, particularly when the material tends to be slabby. High circulating loads enhance cubicity by reducing the reduction ratio at each pass.

Crushing rolls readily pass slabs. However, choke feeding increases the cubicity of the roll product, as does increased roll speed and decreased reduction ratios. Special roll drives which maintain differential surface speeds of the two rolls increase cubicity of the product, but by the same token increase wear on the roll shells. Although rolls with sharp corrugations and highly differential speeds are very effective, they are limited to soft, nonabrasive materials which will not dull or destroy the corrugations.

We can best prepare spherical particles, or cubical ones with rounded corners, by first reducing under conditions of maximum cubicity and then subjecting the particles to a gentle rubbing or rolling reduction by attrition under contact forces which are not enough to break the particles but will wear off the sharp corners.

We can sometimes improve considerably the cubicity of a naturally slabby material by controlled crushing and grinding conditions, but the cubicity of ordinary rock without a bedded or lamellar structure is affected relatively little by these same conditions.

Beyond these observations, we can't formulate any general rule that one type of reduction machine is superior to other types under all operating conditions.

Table III—Dimensions and Shape Factors for Various Materials

Material	Size Fraction						
	1½ in. × 1 in.	1 in. × ¾ in.	¾ in. × ½ in.	½ in. × ¾ in.	¾ in. × 3 mesh	3 mesh × 4 mesh	4 mesh × 6 mesh
Dimension C (Over-all average = 0.581)							
Coal I	0.595	0.609	0.616	0.626	0.683	0.758	0.880
Coal II	0.635	0.586	0.592	0.616	0.662	0.697	0.796
Coal III	0.609	0.570	0.520	0.538	0.538	0.538	0.538
Lead	.....	.....	0.604	0.602	0.548	0.589	0.641
Clay	.....	.....	0.681	0.595	0.597	0.630	0.566
Syenite	0.496	0.605	0.558	0.514	0.455	0.435	0.447
Quartzite	0.458	0.500	0.525	0.495	0.466	0.465	0.516
Average	0.559	0.574	0.585	0.570	0.564	0.587	0.626
Dimension A (Over-all average = 1.234)							
Coal I	1.038	1.185	1.179	1.237	1.282	1.262	1.292
Coal II	.....	1.156	1.185	1.236	1.313	1.214	1.214
Coal III	1.071	1.195	1.290	1.326	1.242	1.289	1.655
Lead	.....	.....	1.053	1.146	1.110	1.245	1.136
Clay	.....	.....	1.031	1.010	1.116	1.138	1.180
Syenite	.....	1.143	1.144	1.271	1.360	1.582	1.525
Quartzite	1.100	1.255	1.183	1.433	1.571	1.411	1.810
Average	1.070	1.187	1.152	1.237	1.285	1.306	1.402
Shape Factor (Over-all average = 0.846)							
Coal I	0.950	0.906	0.908	0.874	0.778	0.644	0.570
Coal II	.....	0.856	0.855	0.785	0.784	0.674	0.600
Coal III	0.891	1.046	1.106	1.010	0.917	0.950	1.116
Lead	.....	.....	0.742	0.887	1.036	1.005	1.000
Clay	.....	.....	0.671	0.966	0.998	0.948	1.126
Syenite	.....	0.544	0.723	0.828	0.846	0.787	0.814
Quartzite	0.538	0.646	0.741	0.913	1.000	0.886	0.827
Average	0.793	0.800	0.821	0.895	0.908	0.842	0.865

Particle Size Determines Work Input

Particle size is more important in most size-reduction operations than particle shape.

According to the "third theory" of comminution[1,6] [a more appropriate name would be the "Bond theory"—Ed.], the useful work input per ton is inversely proportional to the square root of the product diameter. This principle of work equivalence requires that each regular size fraction of a homogeneous comminution product which has been reduced under ideal conditions of work distribution represent an equal amount of work input.

A work-equivalent product which has 80 percent passing a ¾-in. square will have 40 percent passing 4 mesh, 20 percent passing 14 mesh, 10 percent passing 48 mesh and 5 percent passing 200 mesh. A reduction of three-fourths in the product diameter, with a reduction ratio of 4:1, results in a reduction of one-half in the percent passing that size.

It follows that a log-log plot of percent passing as ordinate vs. particle diameter of a work-equivalent product as abscissa forms a size-distribution line with a slope of 0.5. Variations from this work-equivalent slope result from diversities or inhomogeneities in the material and/or selective reduction of certain particle sizes.

How to Characterize Particle Size

The fundamental size distribution law of crushed and ground products apparently was first discovered by Gates.[3] He showed the percent-passing screen analyses of several materials plotted on log-log paper as a straight line and gave a general equation for the distribution lines. Gaudin[4] restated and amplified this principle. Later, Schuhmann[5] developed the distribution-line equation in its present form.

The Gates-Gaudin-Schuhmann (GGS) distribution line has the following equation:

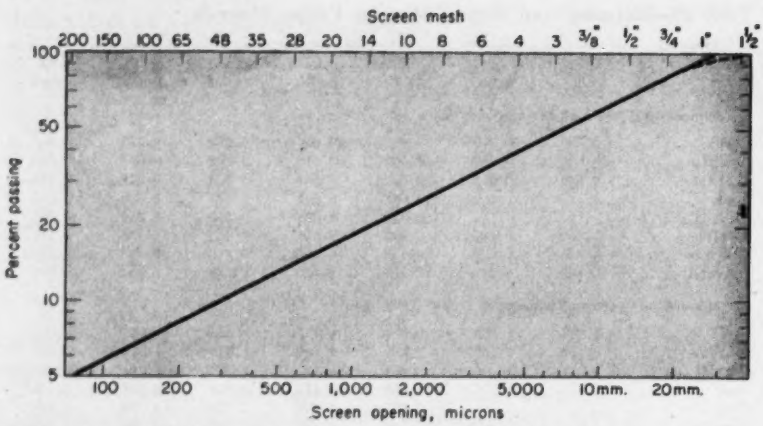
$$y = 100(x/k)^m = 80(x/p)^m \qquad (3)$$

where y is the percent passing any size x, k is the size 100 percent passes, p is the size 80 percent passes and m is the slope of the plotted line.

We can write Eq. (3) for a work-equivalent product as follows:

$$y = 100(x/k)^{0.5} = 80(x/p)^{0.5} \qquad (4)$$

The GGS line usually doesn't continue straight to the 100 percent-passing size, but curves to a flatter slope near the upper end (see cut). One reason for this curvature is that larger product particles from reduction machines tend to have a less regular shape than the smaller particles, and these slabby or acicular particles are retained on larger square mesh openings. Another reason may be that many reduction machines discharge some abnormally large particles as "tramp oversize." The straight portion of the GGS line often begins at about the 80-percent-passing size, and the slopes



SIZE distribution line for work-equivalent product has slope of 0.5.

above and below 80 percent can be considered separately.

When we change an open-circuit reduction process to closed circuit, or when we increase the circulating load of a closed-circuit process, the slope of the distribution line increases and the flattened portion above 80-percent-passing becomes steeper. Increasing the circulating load is the usual method of decreasing the content of tramp oversize and extreme fines, but there are definite limitations to what can be accomplished along this line.

How Feed Diversities Affect Operations

Most naturally occurring materials exhibit some diversity which affects their manner of breakage, such as a natural grain size, veinlets, partially formed cracks resulting from ground movement or the use of explosives, a laminated structure, a porphyritic structure, and finely divided material present as a filling or cement.

Most of these structural diversities, considered alone, would make a material easier to crush and harder to grind fine; in other words, they would cause the work index W_i to be lower for crushing than it is for grinding. However, if the diversities are evenly distributed, or homogeneous, in the different size fractions considered, the work index will be constant for the different fractions.

The work index[1,2] is the equivalent work input in kwh. per short ton required to reduce from theoretically infinite feed size to 80 percent passing 100 microns, equivalent to about 67 percent passing 200 mesh. It can be calculated as follows:

$$W_i = W\,(P/100)^{0.5}\,(R^{0.5}/R^{0.5}-1) \quad (5)$$

where W is the kwh. per short ton for an actual reduction step, R is the reduction ratio F/P, F is the size in microns of the square hole through which 80 percent of the feed passes and P is the hole size through which 80 percent of the product passes. For a work-equivalent product the work index remains constant for all feed and product sizes.

Theoretically, if there were no diversity whatever and a material were completely homogeneous throughout, there would be no localization of stresses to form crack tips; stress localization would result entirely from the mode of application of the force and the shape of the piece being broken. A cube of such material under an evenly applied compressive stress would tend to fail suddenly with the formation of a fine powder, and an extremely high work index for crushing.

Various artificial materials, such as solidified furnace products and residual petroleum coke, are less diversified than most slowly cooled rocks and minerals. Their crushed or ground products form more regular and steeper size-distribution lines, when plotted graphically, than do most naturally occurring ores and rocks.

Physical diversities of a material usually tend to decrease its work index at coarser product sizes and flatten the GGS line below the work-equivalent slope of 0.5. However, diversities which are confined to the larger pieces only—for example, the bedding planes in taconite iron ore—tend to increase the work index for crushing above that for grinding, because they restrict the number of possible failure points.

How Machine Action Affects Size

In crushing and coarse grinding with rod and ball mills much of the work is transmitted through the coarse particles to the fine particles. When the coarse particles fail easily because of physical diversities a larger proportion of the total applied work is done on the fine particles.

Crushing between surfaces with a constrained movement, such as in jaw and gyratory crushers, results in direct application of crushing force to only the larger particles. Since the work is selectively applied to the larger particles conditions of work equivalence do not obtain, and the slope of the GGS line is usually steeper than 0.5; in many crushing installations it approaches 1.0. Because of the steeper slope of the feed and product lines the work index is reduced.

Physical diversities in the material which make the coarser particles easier to break than the finer ones reduce the apparent work index in crushing.

Most materials have physical diversities which may be larger or smaller than the amount necessary to produce a work-equivalent product. All are reduced selectively in crushers. These factors may tend to neutralize each other, but they all affect the work index in crushing and grinding. When the diversity effect and the selective crushing effect counteract each other, plant determinations of the work index in crushing are about equal to those in grinding. However, when the physical diversities are slight the work index in crushing may be greater than that in grinding, and vice versa.

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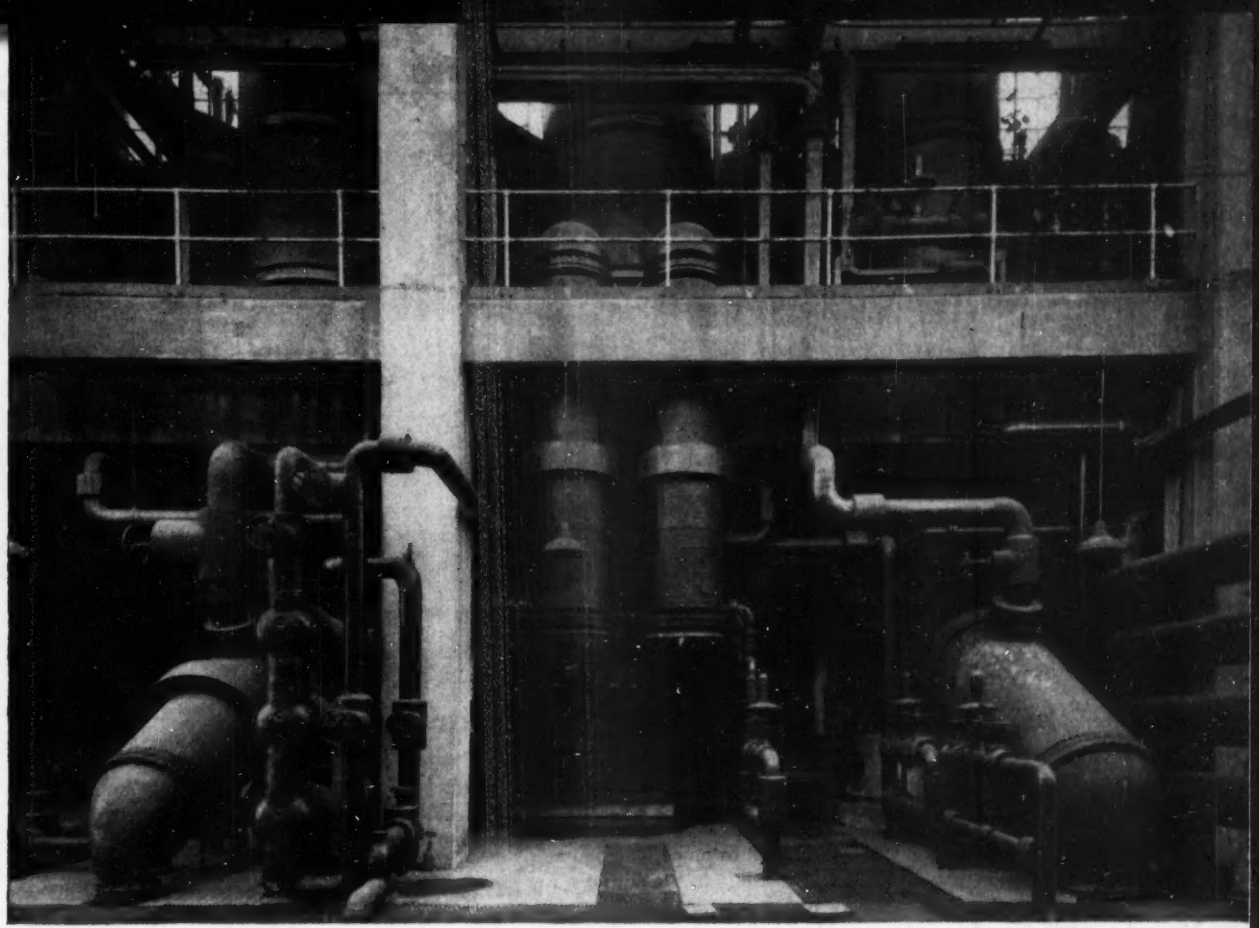

NATURAL CIRCULATION REBOILERS (both vertical and inclined) such as can be designed in accordance with this article.

Shortcut to Heat Exchanger Design—VII

You can cut in half the time for designing heat exchangers by the conventional methods. Here's how for the important class of heat exchangers known as reboilers.

C. H. GILMOUR

To those familiar with the subject of heat transfer to boiling liquids, it may be somewhat presumptuous to suggest a shortcut method for the design of reboilers. The fact remains that reboilers and vaporizers occur as frequently in the design of chemical and petroleum processing plants as other types of heat exchangers—and a shortcut method for their design is both desirable and feasible.

Reboilers supply heat for the operation of distillation columns by vaporizing part of the residue from the base of the column. This is done in the shell side of a horizontal, kettle-type reboiler—or in the tube side of a vertical or inclined natural-circulation reboiler. Other uses of this type of heat exchange equipment include (1) vapor generators for vapor supply to vapor-phase reaction systems, and (2) steam generators to remove heat from reaction systems.

Mechanism of heat transfer by nucleate boiling is clearly described in the current heat transfer literature and familiarity with the subject is assumed before applying the shortcut method. Don't forget that vaporization can result from heat transfer by natural convection, by forced convection, from falling films, and other means or various combinations of these mechanisms. We are dealing in this article with systems in which the heat transfer is essentially by the mechanism of nucleate boiling. As this is a very common occurrence, this method has wide application.

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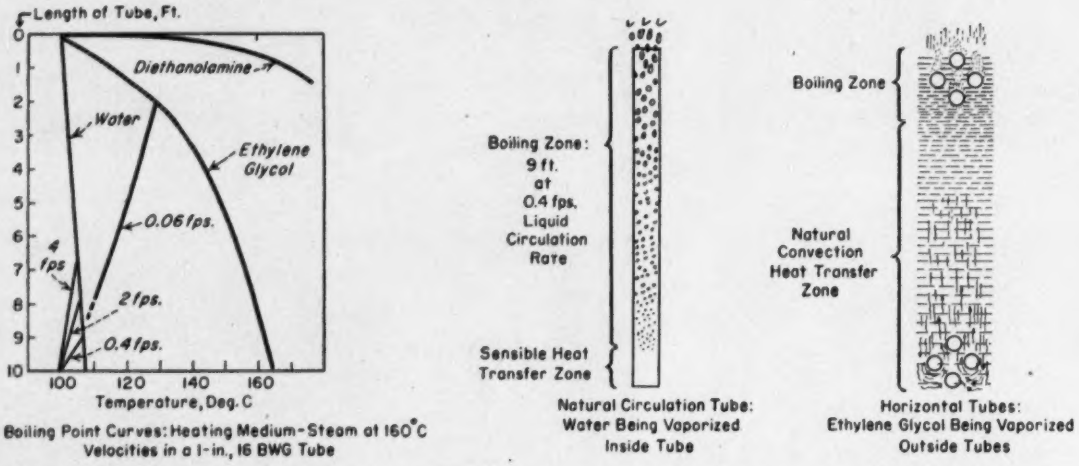
DEVELOPMENT OF METHOD

Basis for the consideration of nucleate boiling is an expression developed by the author which (1)

FOR: What's Behind the Shortcut Method for Reboilers . . .

TURN PAGE



VAPOR GENERATED for various liquid flow rates can be figured from boiling point curves at the left. Note that . . .

What's Behind the Shortcut Method for Reboilers

• You Don't Have to Figure Liquid Flow Rates

Most designers of heat exchangers think that the rate of liquid flow is vitally important to properly design a natural-circulation reboiler. According to the author's method, it is not necessary to know or even estimate what this flow rate is. (This rate is governed, of course, by the difference in density between an aerated column of liquid inside the tubes and an unaerated column in the return line to the calandria.)

Refer to the curves for water above which show the predicted performance of a 1 in. OD × 16 BWG tube, 10 ft. long, for three different circulation rates.

The curves labeled with velocities of 0.4, 2 and 4.0 ft. per sec. correspond to circulation rates of 2.5, 12.5, and 25 lb. of liquid per pound of vapor respectively. The actual circulation rate probably lies in this range.

Data presented in the above table show that even with this ten-fold variation in assumed circulation rate there is a surprising amount of compensation of the variables. Net result is that if the circulation rate is ignored and the heat load calculated on the assumption that the entire tube is transferring heat by mechanism of nucleate boiling and steam condensation, the agreement in results is within 4 percent.

In the plot, the line drawn from 0 ft. to 10 ft. represents the boiling point curve. The rise in boiling point of course is due to the effect of hydrostatic head. The curves starting at 10 ft. and terminating at the boiling point curve represent the heating curves in which the liquid being returned to the bottom of the natural-circulation reboiler receives heat by sensible heat transfer until the boiling point is reached. From this point on, boiling takes place and the heat added in the sensible heat zone appears as latent heat in the boiling zone. Higher circulation rates mean more sensible heat, more area for sensible heat, and more available temperature difference—but also less area for boiling.

The curve for ethylene glycol represents an extreme case. Here the glycol is boiling under vacuum and the effect of hydrostatic head is more pronounced than it was for water. In this case only 2 ft. of the tube is in the boiling zone and the amount of liquid circulated is very low resulting in a small amount of sensible heat transfer. A natural-circulation reboiler for these conditions is not recommended because it is possible to design a forced-circulation vaporizer for this service which will contain considerably less surface area. Note that even for this extreme case, if the nucleate boiling mechanism is applied to the entire length of the tube, the net result is the same as when the flow rate is known and the length is divided between sensible heat transfer and nucleate boiling heat transfer.

To obtain the temperature difference for the case of the 10 ft. of length it was assumed that the 5 deg. minus ΔT at the bottom would be cancelled in effect by 5 deg. plus ΔT so that the net mean ΔT would be the log mean of 60 deg. C. and 5 deg. C. Actually most materials boiling at atmospheric pressures or above would have curves which look like the water curve. In general, natural-circulation reboilers in vacuum service are not recommended. By drawing the boiling point curves the designer can decide whether or not nucleate boiling should be considered.

The curve for diethanolamine boiling at 100 deg. C. was placed on the plot to show how absurd it would be to consider a natural circulation reboiler for these conditions. With steam at 160 deg. C. the ΔT has reached zero at 6 in. below the top of the tube, and only this length could possibly be in the boiling zone.

• Maximum Flux Taken Care of Automatically

In the discussion of vertical natural-circulation reboilers, nothing has been said about maximum flux

Material Boiled	Boiling Length, Ft.	Circulation Rate, Lb. Liq./Lb. Vapor	Liquid Velocity, Ft./Sec.	Over-All Heat Transfer Coeff., Btu./Hr./Sq. Ft./°F.		ΔT Mean, °C.	Heat Load, Btu./Hr.			Vapor Generated, Lb./Hr.*
				Sensible	Boiling		Sensible	Boiling	Total	
Water.....	10	Unknown	Unknown	.....	515	56	None	136,000	136,000	140
Water.....	9	2.5	0.4	175	525	56.5	4,670	126,000	130,670	135
Water.....	8	12.5	2.0	348	545	57.0	18,700	116,000	134,700	139
Water.....	7	25.0	4.0	415	545	57.5	33,600	103,000	136,600	141
Ethylene glycol.....	10	Unknown	Unknown	.....	161	22.0	None	16,860	16,860	44.5
Ethylene glycol.....	2	1.39	0.06	13	354	44	2,160	14,700	16,860	44.5

* Natural circulation reboilers.

. . . CONSTANT VALUES are obtained for the amount of vapor generated. Significance: No need to figure liquid flow rates.

or any other maximum conditions. Actually this is automatically taken care of by the limitations imposed by the heating medium. Thus, as the boiling coefficient increases, the steam coefficient decreases and—as long as a complete design is considered—it is not necessary to worry about maximum flux or maximum ΔT. The literature on boiling coefficients states that there is a maximum temperature difference above which equipment should not be designed.

• Approach Is Different with Horizontal Tubes

Horizontal tubes are subject to a different analysis. Consider a horizontal tube from 8 to 10 ft. below the liquid level where the above conditions for ethylene glycol apply. With steam at 160 deg. C. it is impossible for this tube to boil glycol. Heat would be transferred by natural convection and of course the nucleate boiling mechanism does not apply. Even so the natural convection heat transfer will be rather high because of the large ΔT and vapor will be generated when the heated liquid reaches the surface. This condition occurs in large batch still kettles but this computation method must not be used for designing equipment operating under these conditions.

In continuous distillation systems, the liquid level is usually carried just above the tube bundle and a tube in this zone may transfer heat by the mechanism of nucleate boiling. However for a horizontal tube there is a maximum flux which is a function of the material being boiled and the dimensions of the tube or tube bundle.

Consider a single tube near the surface such as the tubes indicated pictorially above. Jakob* has shown that vapor bubbles rise at a velocity of from 0.56 to 1.3 ft. per sec. The mechanism of nucleate boiling breaks down because if an attempt is made to create vapor bubbles beyond this rate the bubbles cannot get away from the surface and a vapor envelope begins to form around the tube. A single tube 1 in. diam. and 10 ft. long will have a maximum vapor generating rate of 63 lb./hr. when boiling water at 100 deg. C. by the mechanism of nucleate boiling.

$$0.56\ \frac{\text{ft.}}{\text{sec.}} \times 0.0374\ \frac{\text{lb.}}{\text{cu. ft.}} \times 1/12\ \text{sq. ft.} \times 10 \times 3{,}600\ \frac{\text{sec.}}{\text{hr.}} = 63\ \text{lb./hr.}$$

Notice that the projected area of the tube is used and not the surface area. The maximum flux under these conditions is $63 \times 970 / 2.62 = 23{,}300$ Btu/hr./sq. ft. In a tube bundle 24 in. diam. with a tube circle of 21.625 in., and with the tubes on 1.4 in. square pitch, the maximum vapor rate will be 1,335 lb./hr. for the total of 165 tubes in the bundle. Here the maximum flux is only 3,040 Btu./hr./sq. ft. For the case of ethylene glycol boiling at 100 deg. C. on the single tube described above, the maximum vapor rate would be 4.65 lb./hr. and the maximum flux 670 Btu./hr./sq. ft.

We do not contend that it is impossible to generate more vapor than this from this tube, but we do contend that beyond these values the mechanism of heat transfer is no longer pure nucleate boiling. To protect the designer, we have added a factor to the computation sheet which states that the quotient $6.65\ W_v/\rho_v D_o L_o$ should not exceed a value of 1.

• Method Applicable to Inclined Reboilers

These design equations may be used for the design of inclined reboilers also. Results will be somewhat conservative because of the more favorable ΔT and the more favorable condensing coefficient when the heating medium is a condensing vapor. However, inclined reboilers have disadvantages, too. The slight advantage in surface hardly warrants a design method for inclined reboilers other than the one presented here. Don't use an inclination of less than 15 deg. from the horizontal.

*Jakob, "Heat Transfer," Vol. I, p. 632, John Wiley & Sons, (1949).

satisfactorily correlates single tube experimental data, and (2) succeessfully produces designs for commercial-sized vaporizing equipment.

Fundamental formula for the film coefficient of heat transfer is Eq. VII—1. Note the similarity to the Colburn equations used previously in these articles. Third term in this equation takes care of the effect of pressure. The symbol ρ_L is the liquid density, σ is the surface tension, and P is the pressure; all terms in consistent units. All other symbols have been described previously—but it is important to note that the mass velocity G is defined as the weight rate of vapor produced per square foot of surface area multiplied by the ratio of the liquid and vapor density.

This equality is shown in equation VII—2. Value of the proportionality function ϕ varies with the nature of the surface. For smooth, clean, copper tubes it is 1×10^{-4}; for chromium or stainless steel surfaces it is 0.6×10^{-4}; and for polished surfaces it is 0.4×10^{-4}.

When the Weber equation for thermal conductivity is substituted in Eq. VII—1, and consistent units are converted to common units, we obtain the dimensional Eq. VII—3 for the heat transfer coefficient for the boiling film.

Eq. VII—4 indicates the familiar heat balance equation which is solved for the temperature difference across the boiling film in Eq. VII—5. Dividing the previous equation by the mean temperature difference gives the fraction of the total temperature difference required across the boiling film, and this ratio is shown in Eq. VII—6. When this equation is expanded in the manner described in previous articles we obtain Eq. VII—7 which combines the various terms into the familiar numerical, physical property, work, and mechanical design factors.

Because data on the vapor density are sometimes available, it is advisable to include this term in a second physical property term along with the operating pressure. When the vapor density is unknown, it is necessary to calculate it. Then the second physical property factor Fp' has different terms in it as shown in Eq. VII—9. If extreme accuracy is not required in calculating the vapor density, you may use a value of 1 for the compressibility factor. Methods of estimating compressibility factors are available in the literature for those desiring to be more exact.

Numerical factors in Eqs. VII—7 and VII—9 apply when temperature and temperature difference are in degrees Fahrenheit. When degrees Centigrade are used these numerical terms are 0.352 and 0.045 respectively.

Factors in the first physical property factor have been defined except for σ, the surface tension. Units of surface tension are dynes per centimeter. In the second physical property factor, units of vapor density (ρ_v) are pounds per cubic foot, and the units of pressure (p) are pounds per square inch absolute.

When Fahrenheit units are used for temperature and temperature differ-

About Shortcuts to Heat Exchanger Design.

NOTE—*This article completes the series of mechanisms by which 90 percent of the heat exchangers used by industry can be designed.*

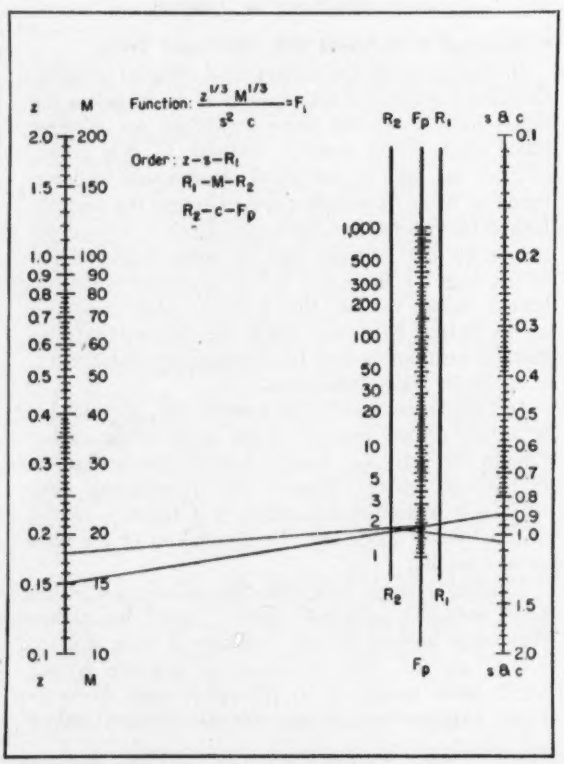
The first article in this series (Oct. 1952, p. 144) developed a basic method for the design of heat exchangers. Use of the method for conditions of no phase change, forced convection, turbulent flow, and cross flow in shell was described.

Article II in March 1953 issue described use of the basic method for no phase change, forced convection, turbulent flow, and parallel flow in shell.

Article III in April 1953 issue dealt with heaters and condensers in which the condensing vapors contain no more than a small amount of super-heat or non-condensible vapor.

Article IV in the October 1953 issue dealt with condensers and subcoolers in which the condensate consists of miscible fluids, Article V in the February 1954 issue with condensers and subcoolers in which the condensate consists of immiscible liquids, and Article VI in the March 1954 issue with condensation of vapors from mixtures of vapor and non-condensable gases.

It will be necessary to refer to the first article for certain alignment charts, nomenclature, as well as development of the basic method. When you do, please note that W_v' was omitted under work factors for pressure drop in Eq. VII. In this same equation the exponent on the term P is a 3.—EDITOR.



LIQUID PHYSICAL PROPERTY FACTOR for heat transfer. For vapor-in-shell or vapor-in-tube condensers.

ence, use degrees Rankine (deg. F. + 460) for T; and when degrees Centigrade are used for the functions above, use degrees Kelvin (deg. C. + 273) for T.

Subscipts in the molecular weight terms refer to liquid (L) and vapor (v) respectively. Note that in boiling processes these molecular weights may often be quite different.

The compressibility factor has no units and the usual symbol for this term is Z, but to eliminate confusion with the viscosity term used in this series, this was not used here.

The design equations apply to both horizontal units with boiling outside tubes and vertical units with boiling inside tubes. Since space is at a premium on the computation sheet, because of the necessity of including columns for sensible heat transfer and latent heat transfer, only one column has been provided for boiling. The usual subscripts are therefore not shown but you will realize that the physical properties apply to the fluid being boiled whether on the inside

Design Equations

$$\frac{h}{cG}\left(\frac{c\mu}{k}\right)^{0.6}\left(\frac{A\sigma}{P^2}\right)^{0.425} = \frac{\phi}{\left(\frac{DG}{\mu}\right)^{0.3}} \qquad \text{(VII-1)}$$

$$G = \frac{W}{A}\cdot\frac{\rho_L}{\rho_V} \qquad \text{(VII-2)}$$

$$h = 0.316\ \frac{c\ s^{1.075}\ p^{0.85}}{z^{0.3}\ M_L^{0.2}\ \sigma^{0.425}\ \rho_V^{0.7}}\ \frac{1}{d^{0.3}}\left(\frac{V}{A}\right)^{0.7} \qquad \text{(VII-3)}$$

$$hA\,\Delta T = W\lambda \qquad \text{(VII-4)}$$

$$\Delta T = \frac{W\lambda}{hA} \qquad \text{(VII-5)}$$

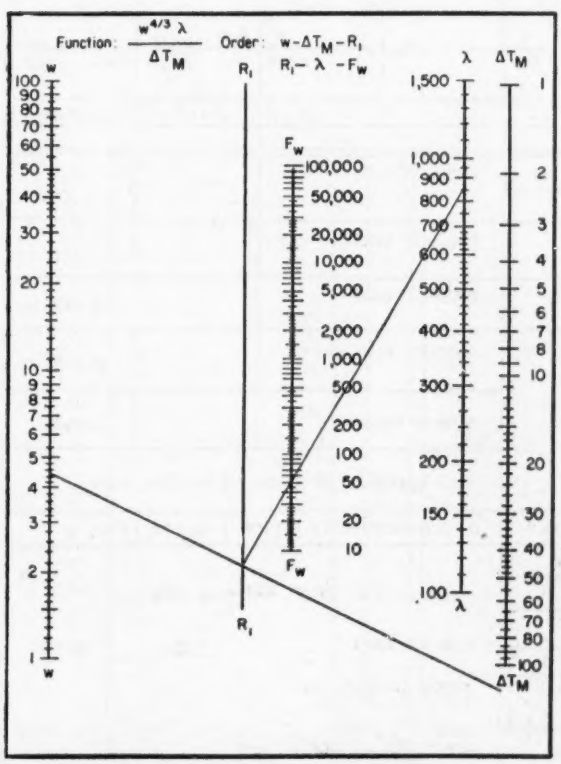
$$\frac{\Delta T}{\Delta T_M} = \frac{W\lambda}{hA\Delta T_M} \qquad \text{(VII-6)}$$

$$\frac{\Delta T}{\Delta T_M} = 0.635\ \frac{z^{0.3}\ M_L^{0.2}\ \sigma^{0.425}}{c\ \ s^{1.075}}\ \frac{\rho_V^{0.7}}{p^{0.85}}\ \frac{W^{0.3}\lambda}{\Delta T_M}\ \frac{1}{(nL)^{0.3}} \qquad \text{(VII-7)}$$

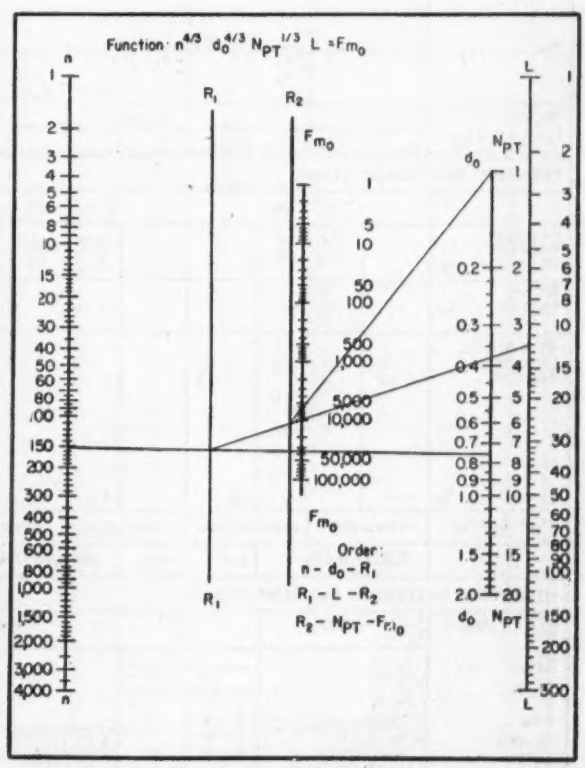
$$\frac{\Delta T}{\Delta T_M} = F_n \times F_p \times F_p' \times F_w \times \frac{1}{F_m} \qquad \text{(VII-8)}$$

$$\frac{\Delta T}{\Delta T_M} = 0.121 \times \frac{z^{0.3} M_L^{0.2}\ \sigma^{0.425}}{c\ \ s^{1.075}} \times \frac{M_V^{0.7}}{p^{0.15}\ T^{0.7}\ \Omega^{0.7}} \times \frac{W^{0.3}\lambda}{\Delta T_M} \times \frac{1}{(nL)^{0.3}} \qquad \text{(VII-9)}$$

$$\frac{\Delta T}{\Delta T_M} = F_n \times F_p \times F_p' \times F_w \times \frac{1}{F_m} \qquad \text{(VII-10)}$$



WORK FACTOR for heat transfer. For vapor-in-shell or vapor-in-tube condensers.



MECHANICAL DESIGN FACTOR for heat transfer. For vertical vapor-in-shell condensers.

COMPUTATIONS FOR HEAT EXCHANGERS
FOR NUCLEATE BOILING OF LIQUIDS INSIDE TUBES OF VERTICAL OR INCLINED REBOILERS
FOR NUCLEATE BOILING OF LIQUIDS OUTSIDE TUBES OF HORIZONTAL KETTLE TYPE REBOILERS
WITH HEATING EITHER BY SENSIBLE HEAT TRANSFER OR BY CONDENSATION OF A VAPOR

HEAT TRANSFER CALCULATIONS:

	TUBE SIDE			SHELL SIDE			TUBE WALL	FOULING
HEAT TRANSFER MECHANISM	SENSIBLE	CONDENSING	✓ BOILING	BOILING	SENSIBLE	✓ CONDENSING	COPPER STAINLESS STEEL ✓	SCALE TAR POLYMER
NUMERICAL FACTOR		POSITION HORIZONTAL	POSITION VERTICAL ✓	POSITION HORIZONTAL	SPACING TRI / SQ	POSITION VERTICAL	BOILING OR CONDENSING / SENSIBLE TRANSFER	SENSIBLE TRANSFER / BOILING OR CONDENSING
F_n GAS	2.48		WHEN	WHEN	0.475 / 0.604			
LIQUID	2.62		ρ_v IS KNOWN	ρ_v UNKNOWN	0.270 / 0.342			
VAPOR °C	—	2.92	0.352	0.0045	— / —	4.75	88 / 159	3820 / 2120
VAPOR °F	—	5.25	0.635 ✓	0.120	— / —	8.55 ✓	159 / 159	3820 / ✓3820
LIQUID PHYSICAL PROPERTY FACTOR	C_l / Z_l / M_l / S_l	C_l / Z_l / M_l / S_l	C 0.73 / Z 0.10 / M 58 / S 0.43 / σ 3.1	2.27 ρ_v / 290 p / 58 M_v / 688 T / — Ω	C_o / Z_o / M_o / S_o	C_o 1.05 / Z_o 0.15 / M_o 18 / S_o 0.89	1 / 1 C / k 26 k	C 1 / 1 h_s 154 h_s
			F_p 6.5	0.00785 Ψ				
F_p	F_{p_i}	F_{p_i}	F_p 0.014		F_{p_o}	F_{p_o} 1.7	0.0385 1/k C/k	0.0065 C/h_s 1/h_s
WORK FACTOR	W_i / t_H-t_L / ΔT_M	W_i / λ_i / ΔT_M	W_i 40.8 / λ_i 97 / ΔT_M 125	W_o / λ_o / ΔT_M	W / T_H-T_L / ΔT_M	W 4.57 / λ_o 868 / ΔT_M 125	W 4.57 λ 868 t_H-t_L ΔT_M 125	W 4.57 λ 868 T_H-T_L ΔT_M 125
F_w							$\frac{W\lambda}{\Delta T_M}$ 31.6	31.6 $\frac{W\lambda}{\Delta T_M}$
							$(t_H-t_L)\frac{W}{\Delta T_M}(T_H-T_L)$	
	F_{w_i}	F_{w_i}	F_{w_i} 2.4	F_{w_o}	F_{w_o}	F_{w_o} 53		
MECHANICAL DESIGN FACTOR	n / d_i / L	n / d_i / L	n 151 / L 12	n / L	n / N_{PT} / L / P	n 151 / N_{PT} 1 / L 12 / d_o 0.75	d_o 0.75 / d_i 0.62 / d_o-d_i 0.13	n 151 / d_o 0.75 / L 12
F_m	F_{m_i}	$\frac{1}{F_{m_1}F_{m_2}}$ 1	$\frac{1}{F_{m_1}}$ $\frac{1}{9.5}$ Σ = 1 - 1.7 - (2.5)	$\frac{1}{F_{m_o}}$	F_{m_o}	$\frac{1}{F_{m_o}}$ 1/6500	$\frac{d_o-d_i}{nd_oL}$ 0.13/1360	$\frac{1}{nd_oL}$ 1/1360
PRODUCT $F_n \times F_p \times F_w \times F_m$			0.036			0.119	0.019	0.576

PRESSURE DROP CALCULATIONS:

	TUBE SIDE			SHELL SIDE		
PHYSICAL PROPERTY FACTOR f_p		$\frac{Z_l}{S_l}$ $\frac{Z_v}{S_v}$ f_{p_i}			$\frac{0.08}{S_{V_o}}$ $\frac{0.326}{S_o}$	
WORK FACTOR f_w		$f_{w_i} = (\frac{W_i}{n})^{1.8}$			W_o^2	
MECHANICAL DESIGN FACTOR f_m	+ 16 + 25 —	L_o/d_i U-BEND OR STRAIGHT SUM X N_{PT} f_{d_i} f_{m_i} f_{m_2}	+ 16 + 25 0.5		$L_o/P^3 D_o$	
$f_p \times f_w \times f_m$	SENSIBLE	CONDENSING	CONDENSING	SENSIBLE		
	Negligible	ΔP P.S.I.		Negligible		

PRODUCT TUBE		0.036
PRODUCT SHELL		0.119
PRODUCT WALL		0.019
PRODUCT FOULING		0.576
SUM OF PRODUCTS		0.750

THIS SUM MUST BE EQUAL TO OR LESS THAN 1

Ω = COMPRESSIBILITY FACTOR | $M_v/T\Omega = \Psi = \rho_v/p$

MEAN TEMP. DIFFERENCE AND TEMP. CHANGE

ΔT_H 125 / ΔT_L	t_H 228 / t_L	HIGH / LOW	353 T_H / T_L
DIFF. RATIO	$\frac{t_H-t_L}{T_H-T_L}$ *	dt / dT: K, R	$\frac{T_H-T_L}{t_H-t_L}$
ΔT_{LM}	t_H-t_L		T_H-T_L
F	t AVE	1 - 2 / 2 - 4 / 3 - 6 / 4 - 8 PASSES	T_H+T_L T AVE
ΔT_M	* OR t_H-T_L WHICHEVER IS LARGER POSITIVE VALUE	F	Σ IS SURFACE CONDITION FACTOR 1.0 = PERFECT 1.7 = AVERAGE 2.5 = WORST
D_o DEG / 24' FT.			

ITEM NO. Ex. 15.5, Kern, p. 488

SURFACE AREA 356 SQ FT.

SPECIFICATIONS SK-

SIZE 151 - 3/4" — 144" — 15"
n — d_o — L_o — D_o

* IF QUOTIENT OF $W_i/n s_i d_i^{2.56}$ EXCEEDS 0.3 F_{m2} = 1.3 OTHERWISE F_{m2} = 1.0
** FOR BOILING: QUOTIENT 665 $W_o/P_v D_o L_o$ SHOULD NOT EXCEED 1 — FOR HORIZONTAL BOILING IN SHELL ONLY

of the tubes or the outside of the tubes.

There is one modification of these design equations which does not appear in the equations themselves but has been included in the design computation sheet—and that is the surface condition factor. Since the proportionality constant in the original equation was 1×10^{-8} and since tests on single tubes and commercial apparatus have indicated that coefficients in accordance with this equation are actually observed, we have chosen to call this condition perfect. For average conditions of surface we suggest a multiplier of 1/ 0.6 or 1.7, and for the worst conditions we suggest a factor or 1/ 0.4 or 2.5.

Experience is the only good guide that will reveal the proper value to be used, because a copper tube boiling a hydrocarbon in a petroleum plant may have a different surface condition factor than a copper tube boiling a synthetic organic chemical in a chemical plant. This factor is not to be confused with a fouling factor—the latter is taken care of in a separate column on the computation sheet. Even if you desire to be ultra-conservative and use a multiplier of 2.5 for all cases, remember that the equation still properly accounts for the variables in the boiling process. Nomographs have been provided to simplify the calculation of the various factors.

EXAMPLE

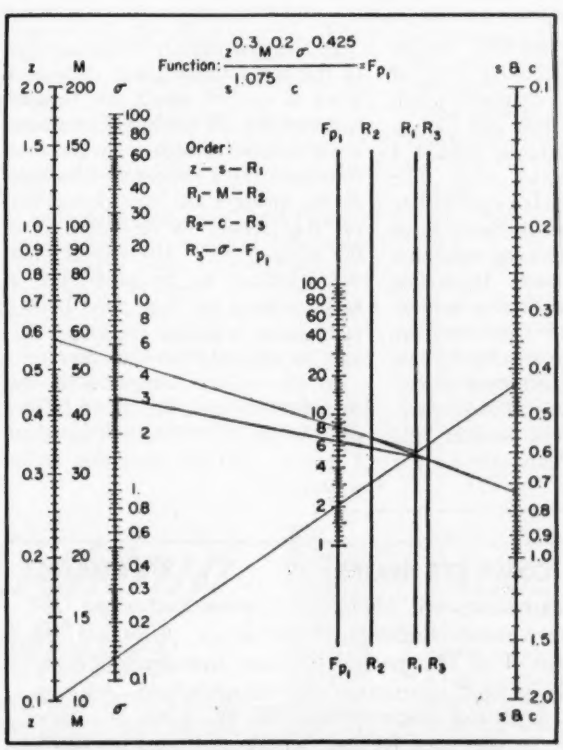
To illustrate heat transfer by nucleate boiling we have used the data of Example 15.5, p. 488, Process Heat Transfer, Kern. The known physical properties for butane are transposed to the computation sheet, together with the other known conditions, and by means of the nomographs the various factors are readily obtained.

Sum of the products is less than unity indicating that in our opinion this reboiler is over-sized. Further computation, however, would indicate that tubes 8 ft. long would be too short and since the next standard tube length is 10 ft. this length would be recommended as the minimum.

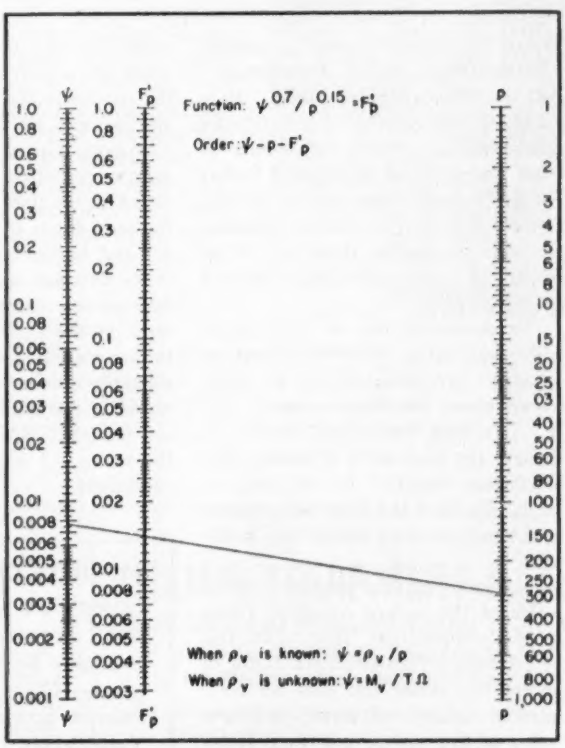
No pressure drop calculations are necessary for this type of heat exchanger although the computation sheet contains the necessary columns for cases in which the heating medium is a gas or a liquid. When the heating medium is a condensing vapor, pressure drop is rarely significant.

Since the methods used for the solution to this problem are extremely different, it would be interesting to compare the film coefficients that apply in the two cases. By the method presented in this article the boiling film coefficient is $576/036 \times 154 = 2{,}470$, whereas in the example as worked out in the textbook, the boiling coefficient was assumed to be 300. The steam film coefficient in our computation is $576/119 \times 154 = 748$, whereas the value used in the other method was assumed to be 1,500.

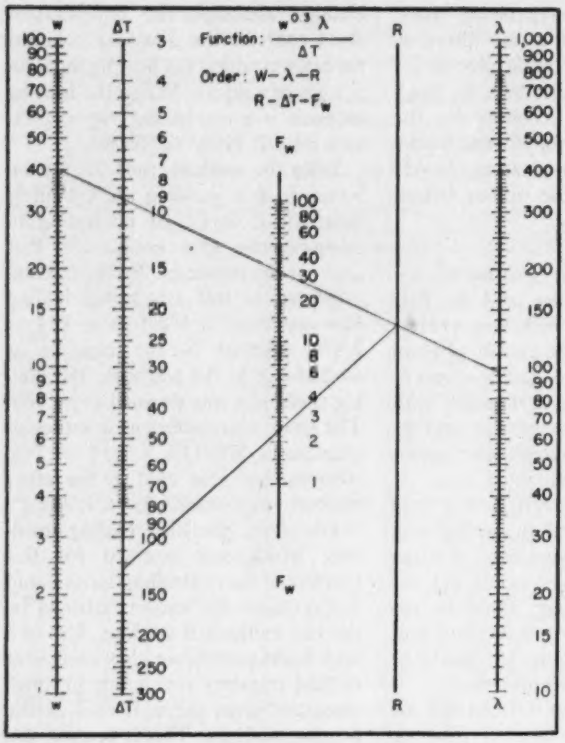
Obviously, the high fouling resistance which was assumed for this problem is the controlling factor—and is the reason the answer obtained by the two methods is so close. Use of a high fouling resistance (low coefficient of heat transfer) is certainly justified, especially when steam is used as the heating medium. This is because you



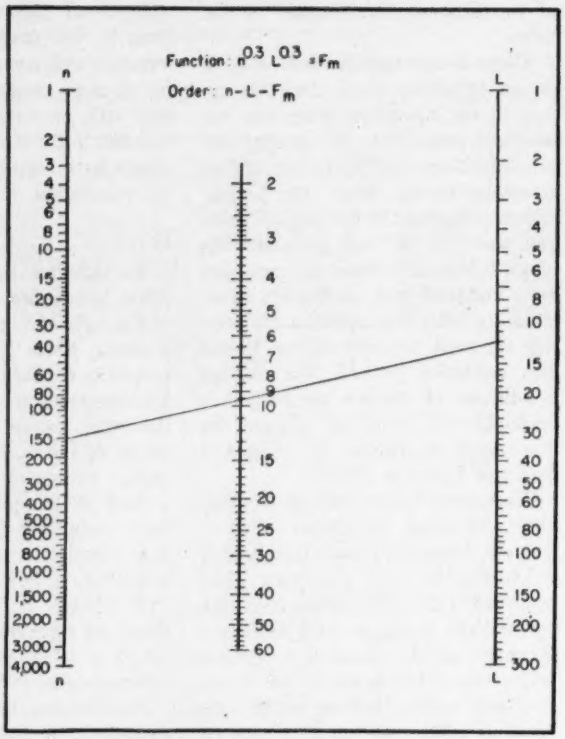
LIQUID PHYSICAL PROPERTY FACTOR. For boiling.



VAPOR PHYSICAL PROPERTY FACTOR. For boiling.



WORK FACTOR. For boiling.



MECHANICAL DESIGN FACTOR. For boiling.

would not want to design a reboiler that would require full steam pressure on its first day of operation. It is suggested that a value of heat transfer coefficient for fouling be chosen so that the products of the four factors in the fouling column will be approximately 0.500. If experience indicates there is no fouling, then there is no reason to include a fouling coefficient in the design.

Experimental data on both single tubes and actual commercial heat exchangers have indicated over-all coefficients above 300 Btu./hr./sq. ft./deg. F. Therefore, we do not hesitate to believe the high value of boiling film coefficient obtained by our method, especially since the operating pressure and temperature are rather high in this case.

Note that we have used the highest value of the surface condition factor in this computation. Here again, this is a means of introducing a factor of safety but actual test data on commercial reboilers will reveal the proper value of this surface condition factor to be used in a certain type of commercial plant. For example, copper tubes when used for boiling many of the synthetic organic chemicals which are produced by Carbide and Carbon Chemicals Co. apparently exhibit a surface condition factor of 1. The factor for stainless steel or steel boiling the same fluids is usually found to be 1.7 and higher factors for any other tube materials are rare. In boiling hydrocarbon materials such as encountered in the petroleum industry, the surface condition factors may be considerably different than those experienced in the synthetic organic chemical industry. We feel, however, that the factor 2.5 is plenty safe for any conditions.

In the temperature difference box of the computation sheet there is a group of symbols which may be used to corect the ΔT for hydrostatic head if the number of degrees rise per foot is known. For a horizontal tube bundle the quotient $D_o/24 \times$ degrees rise per foot should be subtracted from the value of ΔT_M. For vertical units the quotient to be subtracted is $L_o \times$ degrees per foot. If a boiling point curve is drawn, the proper ΔT may be selected from the curve.

In the problem computed on the computation sheet, the rise in boiling point in the 12 ft. length is less than 1 deg. F., and the correction factor is negligible.

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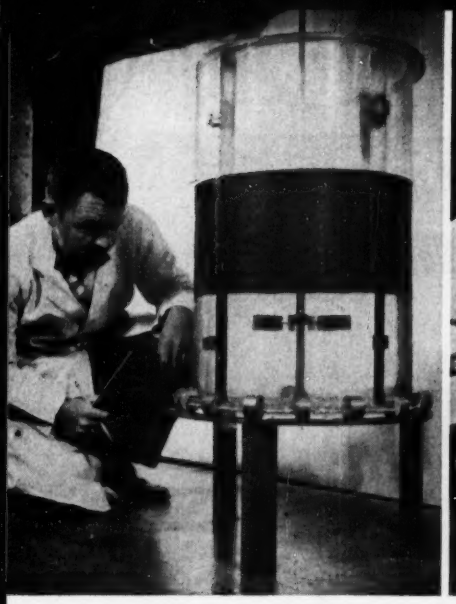

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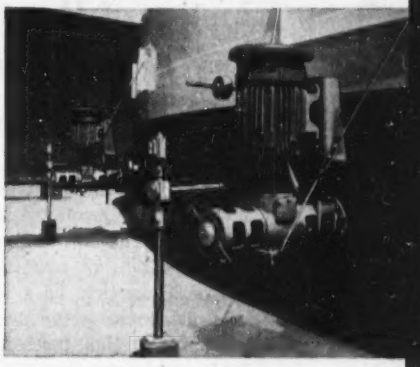

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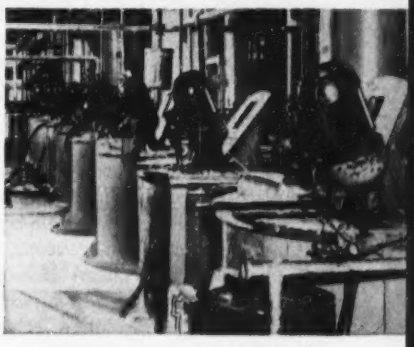

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Chemical Engineering Fundamentals

Kinetics of Homogeneous Reactions—I

THOMAS E. CORRIGAN, Research Engineer, Mathieson Chemical Corp., Brandenburg, Ky.

We introduced the general subject of reaction kinetics last month (*Chem. Eng.*, July 1954, p. 230). Now we're ready for a more detailed account. The kinetics of homogeneous reactions will be covered in three installments. The first will deal with the effects of the concentration of reactants and products on the course of a reaction in a batch process. This will include such topics as the law of mass action, the order of reaction, reaction mechanism, and a summary of methods for determining the order of a reaction.

Types of Homogeneous Reactions

A homogenous reaction is one in which there is only one phase present during the course of the reaction. A reaction between gases where there is no solid or liquid present is a homogeneous reaction. However, if a solid catalyst is added to make the reaction take place, the reaction is no longer homogeneous but is heterogenous.

A reaction between miscible liquids or one that takes place in solution is homogeneous if no precipitate is formed or if no immiscible layer separates out.

Almost all homogeneous reactions are either gas phase or liquid phase. Homogeneous solid phase reactions are rare. They could occur only where there were complete solution between all components.

Homogeneous reactions can also be subdivided into constant volume, constant pressure and also into batch or flow reactions, depending on the type of apparatus used and upon the properties of the system. They can also be isothermal, adiabatic or neither, depending upon the heat of reaction and the heat transfer characteristics of the reactor.

A batch reaction is one in which all materials are charged at one time and no material is removed from the system until the reaction has proceeded to the desired degree of completion. A flow reaction is one in which the reactants are added continually and the products are removed continually. The process is steady state in that at any specific point in the reactor, composition does not change with time. The independent variable in this case is distance along the reactor.

A reaction between gases in a closed batch system is a constant volume reaction. The same gases reacting in a flow system in a reactor tube would be a constant pressure system. Almost all liquid phase reactions can be treated as constant volume reactions since the volume of the reacting mass changes but little with either composition or temperature.

If the temperature remains constant during a reaction, it is isothermal. If no heat is transferred during the process, it is adiabatic.

The most common industrial case is the one in which considerable heat is transferred but there is still a temperature change. The reactor for this type of system can be sized by a tabular method of calculation involving successive approximations.

Some History

Although the rates of some chemical reactions have been measured by a few experimenters in the last century, the formation of the kinetic theory is comparatively recent.[1]

Two early important developments were the observations of Guldberg and Waage on the effect of concentration in 1867 and the observations of Arrhenius on the effect of temperature in 1889. Arrhenius' equation is the basic foundation of our present theory of kinetics.

Until the early 20th century the advances in kinetics consisted largely of empirical measurement. One of the first attempts to theorize was the radiation hypothesis in about 1918.[2] This was disproved and replaced by the modern theories of the collision hypothesis, chain reactions and activated complex. These will be discussed in a future installment.

Effect of Concentration: Law of Mass Action

The important factors of interest for any homogeneous reaction are the effect of the concentration of reactants and products and the effect of temperature upon the rate of reaction. We shall first consider the effects of concentrations.

One of the first postulates concerning the effect of concentration of the reactants upon the rate of reaction is the law of mass action. This law is attributed to

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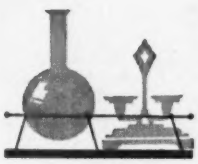

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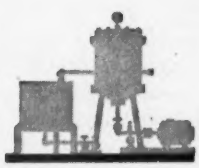

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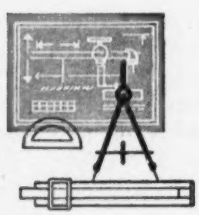

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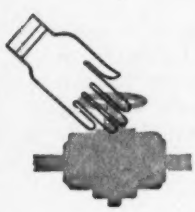

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Nomenclature (Consistent units)

a, b, c	Number of reacting moles of a, b, c, etc.
A, B, C	Reactants
C_A, C_B, C_C	Concentration of A, B, C, etc.
C_{A_0}	Initial concentration of A
d	Differential operator
I	Constant of integration
k	Rate constant
n	Number
P, R, S	Products
r	Rate
t	Time
x	Conversion
Δ	Finite change in a property
Σ	Summation of

Guldberg and Waage[1] and states that the rate of a chemical reaction is proportional to the product of the "active masses" of the reactants involved. Stating this symbolically, if the reaction is

$$A + B \rightleftarrows R$$

the rate is expressed by the equation

$$r = kC_AC_B$$

where C_A and C_B are the "active masses." At first concentrations were used as active masses but it was found that for some reactions the law held more closely if activities were used. However it is extremely difficult to determine the activity of a substance in a mixture of more than two components; and for this reason concentrations are still used in the majority of cases.

Order of Reaction

The common method of classifying homogeneous reactions is by the "order of reaction." If the reaction rate is expressed by the equation

$$r = kC_A{}^aC_B{}^b$$

the order of the reaction is the sum of the exponents a and b. Reactions may have orders of 1, 2, 3, zero, or some fractional value.

The number of reactant molecules which appears in the over-all stoichiometric equation for the reaction is termed the "molecularity." In general there is no relation between molecularity and order of reaction.

In the instances in which the order is equal to the molecularity, the reaction is said to be of "simple order." As an example, a reaction of the type

$$A + B \rightleftarrows 2R$$

may be of any order but its molecularity is two. If the particular reaction should happen to be of second order, it would be a simple order reaction.

Most reactions are not of simple order. Therefore the order can not be predicted from a knowledge of the chemical equation. In some of the earlier literature on this subject there is a tendency to confuse molecularity with order. Some authorities refer to the order of a reaction as the molecularity of the controlling step. Although there is a greater correlation between molecularity of the controlling step and order of a reaction, the fact remains that order is defined merely as the sum of the exponents of the rate equation.

Mechanism of a Reaction

The "mechanism of a reaction" means merely the method by which it takes place. Very few reactions occur in the one step indicated by their stoichiometric equation. Rather, the stoichiometric equation represents only the sum of several reactions which take place as intermediate steps of the over-all process. For instance, the equation for a reaction might be

$$2A + B \rightleftarrows R + S$$

This does not mean that the three reactant molecules simultaneously react in one step. The reaction could possibly proceed as follows:

(1)	$A + B \rightleftarrows AB$
(2)	$A + AB \rightleftarrows A_2B$
(3)	$A_2B \rightleftarrows AB + R$
(4)	$AB \rightleftarrows S$
	$2A + B \rightleftarrows R + S$

If any one of the above steps were slower than the others it would be the rate controlling step. The intermediate products could be molecules, parts of molecules (free radicals) or even, in the case of catalytic reactions, particles of a foreign substance added to the system. Steps (1) to (4) plus a knowledge of which is the controlling step constitute the mechanism of the reaction.

Although a knowledge of the mechanism of a reaction is of academic interest, it is important to the engineer only as a means of obtaining a reliable rate equation which can be used for design purposes. If such a rate equation can be obtained without knowing the mechanism, such knowledge is unnecessary.

How to Determine the Order of a Reaction

The order of a reaction can be determined only from experimental data taken on the reaction itself. It is necessary that the data be taken under isothermal conditions because the value of the rate constant changes rapidly with temperature.

The data taken are usually the concentration of some key reactant or product at various time intervals during the course of the reaction. The order may be determined from plots of data using integral conversions or by using either rates or incremental conversions, $\Delta C/\Delta t$. The plots using total conversion are usually more accurate and are recommended.

First Order Reaction

Consider the reaction below which we will assume is first order:

$$A \rightarrow R + S; r = -dC_A/dt = kC_A$$

A simple plot of the concentration of A against time is a curved line and will not indicate order on inspection. An example is shown in Fig. 1a.

How this condenser shell of HERCULOY was welded

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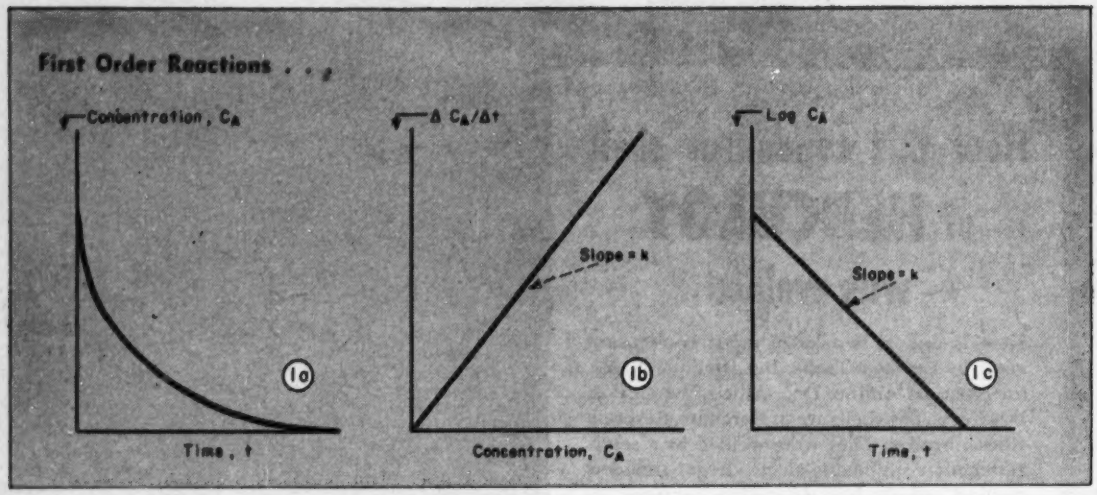

The simplest way to test the order would be to plot incremental data in the form of $\Delta C/\Delta t$ versus C_A, where C_A is taken at the increment average value. If the graph is a straight line of negative slope, the reaction is first order (Fig. 1b). The difficulty with this method is that often the data are so scattered that it is difficult to tell whether the best line through the points is a straight one.

A better method is to integrate the rate equation,

$$-dC_A/dt = kC_A$$

Separating the variables and integrating,

$$-dC_A/C_A = kdt$$

$$-\ln C_A = kt + I \qquad (1)$$

Therefore a plot of ln C_A (or log C_A) against time will be a straight line of negative slope if the reaction is first order. See Fib. 1c.

The equation could be integrated between definite limits thus:

$$-dC_A/dt = kC_A$$

$$-\int_{C_{A_o}}^{C_A} dC_A/C_A = k\int_0^t dt$$

$$\ln C_{A_o}/C_A = kt \qquad (2)$$

Since C_{A_o} (the initial concentration) is known, k can be solved for from the corresponding values of C_A and t. If the values of k are relatively constant, the reaction is first order. But if the values show an upward or downward trend, the reaction is not first order.

Another method is that of using the "half-life" of the reactants. The half-life is the time it takes for one half of the reaction to be completed. For a first order reaction at one-half completion, $C_A = \frac{1}{2} C_{A_o}$

$$\ln C_{A_o}/C_A = \ln 2 = kt$$

$$t = 1/k\ (\ln 2)$$

Thus from a plot of C_A vs. t, the half-life can be read off and k calculated. If the calculated value of k is independent of the initial concentration, the reaction is first order.

There are some other methods of determining the order of a reaction but we recommend the one in which the rate equation is integrated.

Second Order Reaction

If the equation of the reaction has this form,

$$-dC_A/dt = kC_A^2$$

a plot of $\Delta C_A/\Delta t$ versus C_A^2 will yield a straight line. For an equation of the form

$$-dC_A/dt = kC_AC_B$$

a plot of $\Delta C_A/\Delta t$ vs. the product C_A C_B will yield a straight line. These methods are not recommended so highly as the integral method for the same reason we discussed under first order reactions.

The integral form for the equation $-dC_A/dt = kC_A^2$ is obtained as follows:

$$-dC_A/C_A^2 = kdt$$

$$1/C_A = kt + I$$

where I is the constant of integration. Therefore a plot of $1/C_A$ vs. t should result in a straight line, the slope of which is the rate constant. See Fig. 2a.

If the limits of integration are used, the intercept is the reciprocal of the initial concentrations.

$$-\int_{C_{A_o}}^{C_A} dC_A/C_A^2 = k\int_0^t dt$$

$$1/C_A - 1/C_{A_o} = kt$$

$$1/C_A = kt + 1/C_{A_o} \qquad (3)$$

Eq. (3) may be used to solve for k at various values of C_A and t. Constancy of k values indicates a second order reaction.

If the rate for a reaction involving two reactant molecules,

$$A + B \rightarrow \Sigma P$$

is given by the equation $-dC_A/dt = kC_A\,C_B$, the equation can be integrated only if the terms C_A and C_B are expressed as a single variable. Thus, the equation is

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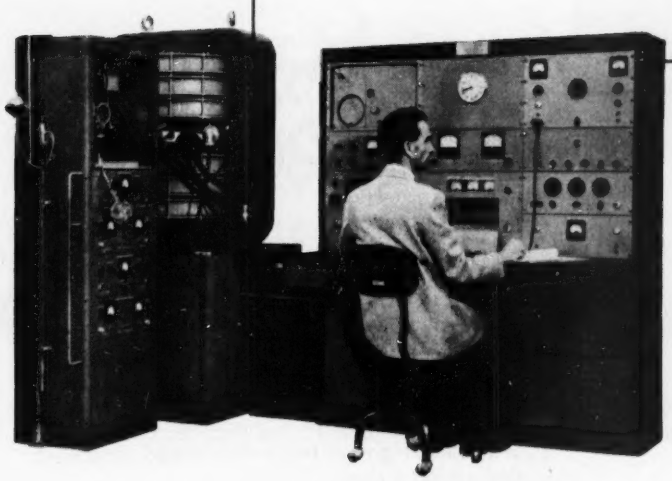

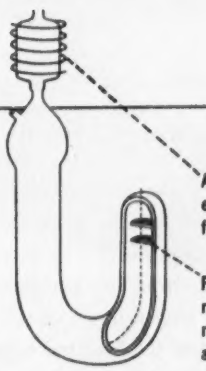

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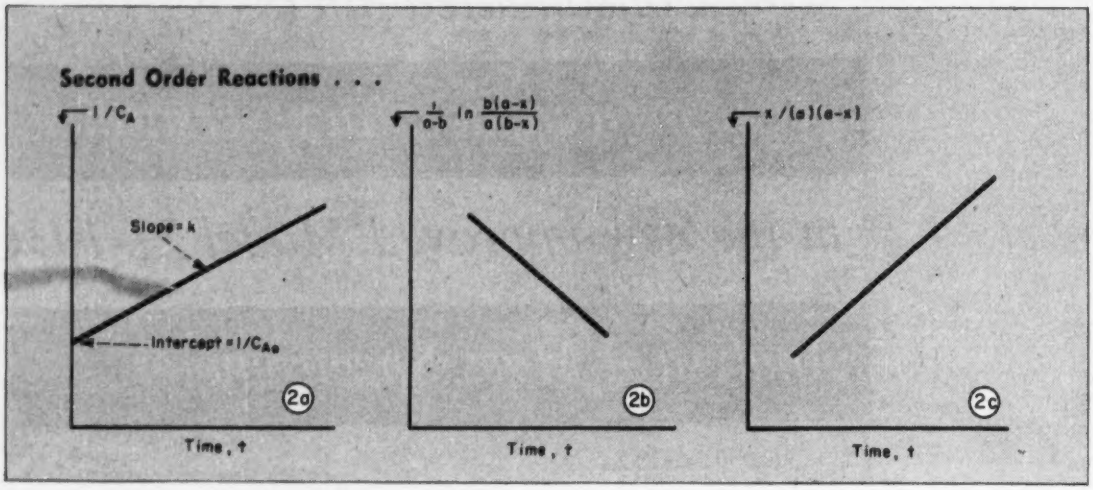


usually transformed to one in terms of conversion, x, and time only.

If a and b are used to denote the initial concentrations of A and B, then $C_A = a - x$; $C_B = b - x$; and

$$-dC_A/dt = -d(a-x)/dt = dx/dt$$

Thus, the rate equation becomes:

$$dx/dt = k(a-x)(b-x)$$

The integrated form of this equation is:

$$[1/(a-b)] \ln [b(a-x)/a(b-x)] = kt \qquad (4)$$

Therefore, a plot of the left-hand term of Eq. (4) vs. t would yield a straight line if the reaction were second order. See Fig. 2b.

An equation of the form $-dC_A/dt = kC_A^2$ could also be expressed in terms of conversion although this is only necessary when two or more reactants are present. Since $C_A = a - x$, and

$$-dC_A/dt = dx/dt = k(a-x)^2$$

and the integrated form of this is:

$$x/a(a-x) = kt$$

A plot of $x/a(a-x)$ vs. t would yield a straight line with slope equal to k, as in Fig. 2c.

Third Order Reaction

If a reaction of the form,

$$3A \rightarrow \Sigma P$$

is third order, a plot of $\Delta C_A/\Delta t$ vs. C_A^3 would be a straight line. Likewise, for a simple order reaction of the form

$$2A + B \rightarrow \Sigma P$$

a plot of $\Delta C_A/\Delta t$ vs. $C_A^2 C_B$ should yield a straight line also. The inherent inaccuracies of this method are great. Therefore, we don't recommend it. The use of the integral equation is superior.

For a simple order reaction such as

$$3A \rightarrow \Sigma P$$

the rate equation is $-dC_A/dt = kC_A^3$. We can separate the variables and integrate:

$$-dC_A/C_A^3 = kdt \quad 1/2C_A^2 = kt + I$$

Therefore, a plot of $1/C_A^2$ vs. t will be a straight line. If we integrate between definite limits,

$$1/C_A^2 - 1/C_{Ao}^2 = 2kt$$

In terms of conversion, x, the above equations are:

$$dx/dt = k(a-x)^3 \quad \text{and,}$$

$$(2ax - x^2)/2a^2(a-x)^2 = kt$$

Zero Order Reaction

If the rate equation is $-dC_A/dt = k$, a plot of $\Delta C_A/\Delta t$ vs. C_A should be a horizontal line. In fact, $\Delta C_A/\Delta t$ should give a horizontal straight line when plotted against t also.

Upon integration $C_A = -kt + I$, and a plot of C_A vs. t should be a straight line whose slope is negative k.

Fractional Order Reactions

The general form of the rate equation where a single reactant is involved is:

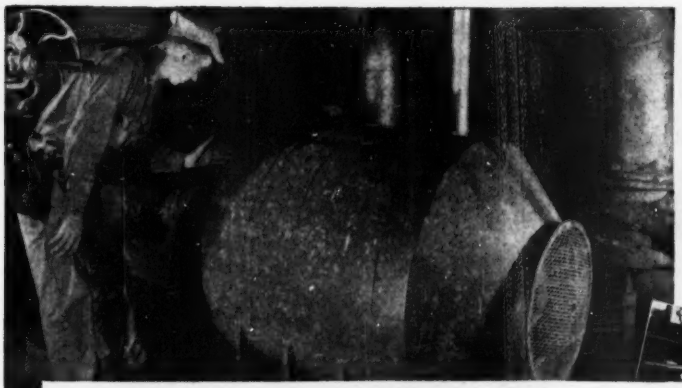
$$-dC_A/dt = kC_A^n$$

We have discussed the cases where n is 0, 1, 2 and 3; but in many cases the value of n may be fractional.

In this case the best approach would be to plot $\Delta C/\Delta t$ against C_A on semi-log paper and to measure the slope. This will give an approximate value for n. Using this value the rate equation is integrated and k is solved for at various values of C_A and t.

If the values of k are not constant but show a trend, another value of n (in the vicinity of the graphical value) is assumed and the k's are recalculated. The value of n that gives the most nearly constant values of k represents the order of the reaction.

We must point out that the methods discussed here



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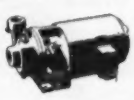

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Summary of Equations for Order of Reaction

Order	Chemical Equation	Rate Equation	Integrated Equation	Units of k
0	$A \rightarrow$ Products	$dx/dt = k$	$x = kt$	concentration/time
1	$A \rightarrow$ Products	$dx/dt = k\,(a - x)$	$\ln a/(a - x) = kt$	1/time
2	$A \rightarrow$ Products	$dx/dt = k\,(a - x)^2$	$x/a\,(a - x) = kt$	1/(time) (concentration)
2	$A + B \rightarrow$ Products	$dx/dt = k\,(a - x)\,(b - x)$	$\frac{1}{a - b} \ln \frac{b\,(a - x)}{a\,(b - x)} = kt$	1/(time) (concentration)
3	$A \rightarrow$ Products	$dx/dt = k\,(a - x)^3$	$\frac{2ax - x^2}{2a^2\,(a - x)^2} = kt$	1/(time) (concentration)^2
3	$A + B \rightarrow$ Products	$dx/dt = k\,(a - x)^2(b - x)$	$\frac{1}{(a - b)^2} \ln \frac{b\,(a - x)}{a\,(b - x)} + [1/(a - b)]\,[1/a - 1/(a - x)] = kt$	1/(time) (concentration)^2
Fractional or General	$A \rightarrow$ Products	$dx/dt = k\,(a - x)^n$	$\frac{1}{n - 1}\left[\frac{1}{(a - x)^{n-1}} - \frac{1}{a^{n-1}}\right] = kt$	$\frac{1}{(\text{time})\ (\text{conc.})^{n-1}}$

are only for specific simple cases. For instance, the method covered for first order reactions was for the common case involving only one reactant. It is feasible to have a reaction of the type $A + B \rightarrow \Sigma P$ obey the following rate equation

$$r = -dC_A/dt = kC_A^{0.4}C_B^{0.7}$$

This would be a first order reaction also (since the sum of the exponents is 1.0) but the method presented above for testing first order reactions would not apply.

Another important limitation of these methods is that they apply only in cases where the rate of the reverse reaction is negligible. In the case of a simple order reversible reaction such as

$$A \rightleftarrows R$$

the true driving force of the reaction is C_A minus C_R/K_e, and the rate equation is

$$-dC_A/dt = k\,(C_A - C_R/K_e)$$

In this instance a plot of log C_A vs. t may not be a straight line even though the reaction is first order.

General Case for a Single Reactant

For the reaction $A \rightarrow \Sigma P$ the general rate equation may be expressed as

$$dC_A/dt = -kC_A^n$$

$$dx/dt = k\,(a - x)^n$$

The integrated form of this equation is[1]

$$[1/(n - 1)]\,[1/(a - x)^{n-1} - 1/a^{n-1}] = kt$$

The table on this page is a summary of rate equations for various order reactions.

Determining Order—A Summary of Methods

We can determine the order of a reaction, and thus its rate equation and the value of its rate constant, by any of these methods:

(1) Plotting the term $\Delta C/\Delta t$ vs. concentration.

(2) Calculating the values of k for various assumed orders and taking the equation which gives the most nearly constant value of k. The important thing is that the value of k does not "drift" up or down even though there is a variation due to experimental error.

(3) Plotting the appropriate integral function for each assumed order and choosing the one in which a straight line is obtained.

(4) Using the time it takes for one half the reaction to take place.

Of the above, we recommend method (3). The procedure to use for this method is as follows:

First, the data must consist of a series of concentration and time values taken at constant temperature. Then plot the appropriate term from Column (4) of the table above against t. When a straight line is obtained, the order is indicated.

To verify, substitute all the experimental values and observe the constancy of k. If there is no trend in k, the order chosen is probably correct.

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2. Daniels, F., "Chemical Kinetics," Cornell Univ. Press, Ithaca, N. Y. (1938).

NEXT MONTH

Kinetics of Homogeneous Reactions—(II) will present some worked-out problems involving the order of reaction, reactor size, consecutive reactions and complex reactions.

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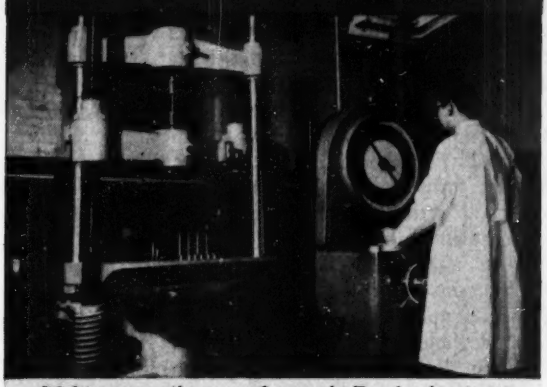

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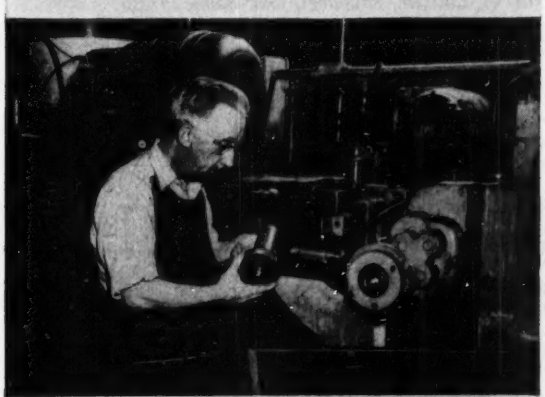

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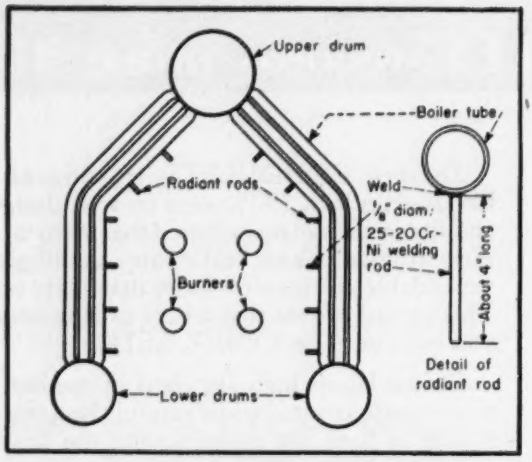

"Hot Rods" on Tubes Show Boiler Temperature Variations

HARLAN HOW, *Equipment Design Consultant, New Bern, N. C.*

★ **May Contest Prize Winner**

During the war there was considerable trouble with four large Dowtherm boilers in the D.P.C. butadiene plant at Kobuta, Pa. We found that the decomposition of the fluid was high and we knew that the operation of the gas burners in the walls of the furnaces was erratic. Overheating of the radiant tube surfaces facing the fire was becoming a serious matter. There had been several cases of badly leaking tubes and it was largely good fortune that we did not have a fire.

When the trouble was discovered and the heaters shut down, it required a lot of thought to find a simple, practical method which would show overheated zones and permit the burners to be adjusted accurately. Conventional methods of temperature indication were obviously not suited in this case since they would be too difficult to apply and probably would not assure positive results.

The solution I worked out was simplicity itself. It enabled the operators immediately to detect any hot spots in the furnace by visual inspection and, hence, to adjust one or more of the multiple burners to obtain a satisfactory temperature distribution. There were no more leaky tubes due to improper burner operation and the entire performance of the heaters was much improved.

This scheme consisted simply in welding 4-in. lengths of ⅛-in. 25-20 Cr-Ni welding rod at right angles to the boiler tubes on the radiant side, so that they projected into the furnace space. These were spaced about 3 ft apart both vertically and horizontally so that the entire inner radiant surface of the boiler was studded with the rods on 3-ft. centers. They were electrically welded to the tubes by a short flash in a manner similar to a stud welder, simply by holding the rod in an ordinary electrode holder.

When the boiler was in use the transfer of heat through the length of the radiant rods would be slow enough, of course, so that their free ends would glow. Variations in the rate of heat release at different points were immediately and vividly visible simply by noting the differences in color temperature of the rods. The method is so sensitive that even the normal fluctuations of gas burners become visible in this way.

There is no reason why this method should not be equally useful in other sorts of radiantly heated tubular equipment, for example, pipe heaters and stills for oil and organic chemicals which are subject to local overheating and decomposition. There is probably less reason to use it in steam boilers than in organic-materials heaters, but even in this case there are doubtless balky boilers that would be helped by it.

For Reliable Control, Keep Your Solenoid Valves in Tune

PAUL C. ZIEMKE, *Engineer, Oak Ridge, Tenn.*

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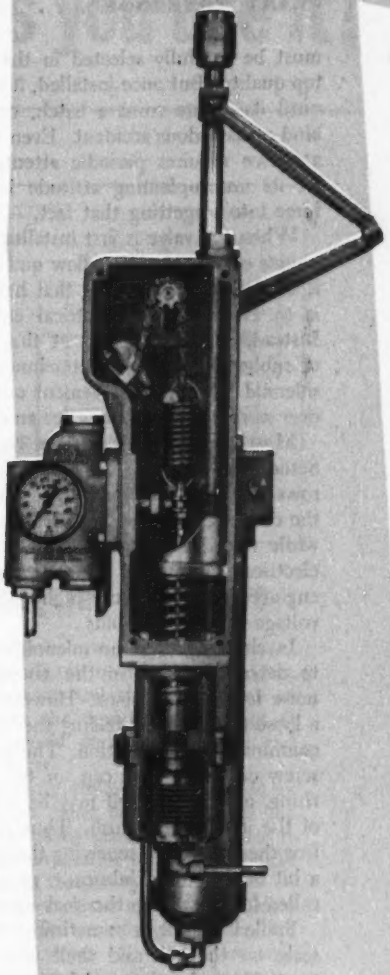
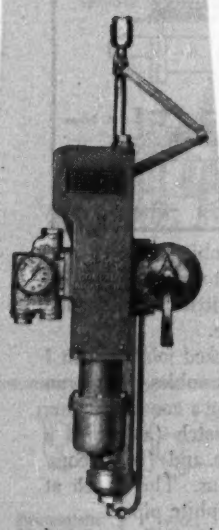
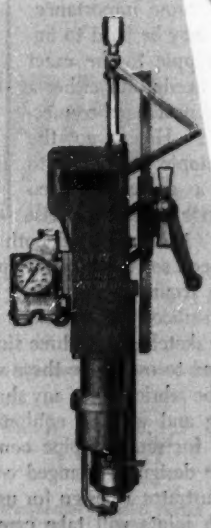
HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable but non-winning articles will be published at regular space rates ($10 minimum).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.







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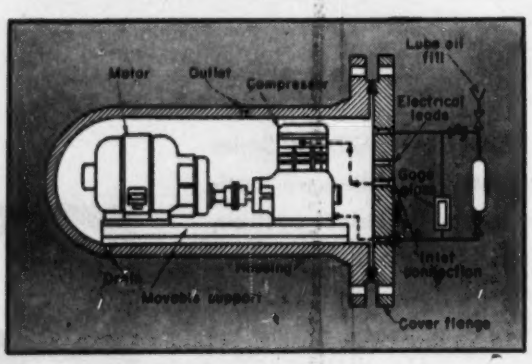
must be carefully selected in the first place to insure top quality. But once installed, it must not be forgotten until its failure ruins a batch, or even leads to some kind of hazardous accident. Even so simple and reliable a device requires periodic attention and care. Don't let its uncomplaining attitude lull your maintenance force into forgetting that fact.

When the valve is first installed, make sure that pipe unions either side of it allow quick exchange if a repair is needed. Another thing that helps quick replacement is to avoid a fixed electrical connection in conduit. Instead, substitute for it at the valve a short length of rubber cord with an attachment plug to power the solenoid through a convenient outlet. A quick change-over won't require waiting for an electrician.

Most solenoid valve failures come from overheating. Some relief can therefore be had by drilling about three rows of holes in the shell to let the confined heat from the coil escape to the air. At the same time, it is worth while to make a check of the voltage supplied, since electrical circuits are often changed, unknown to the engineer, and can cause higher than normal operating voltage for the solenoids.

In checking over the solenoid valves it is often hard to detect looseness in the assembly due to the high noise level of the plant. However, it is easy to detect a loose condition by feeling the vibratory 60-cycle hum common to this condition. The hum may mean a loose screw or nut on the cap, or the plunger may not be rising, or the coil itself may be loose due to drying out of the insulating varnish. Thus it may be necessary to free the plunger by renewing the gland packing or using a bit of solvent or lubricant; or a fiber washer may be called for to take up the slack around the coil assembly.

Spilled chemicals sometimes build up an insulating scale on the solenoid shell which must be removed to avoid overheating and burn-outs of the coil. Attention to these and other difficulties should keep solenoid valves in good order, with little effort and a minimum of chance for unexpected failure.



How to Compress Explosive Gas With Zero Loss Through Shaft Seals

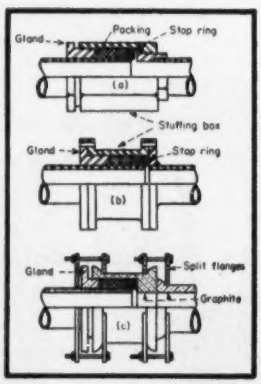
Sinclair Research Laboratories, in a paper on catalytic reforming presented at the Colorado School of Mines on Engineers' Day this spring, described a novel way to use a compressor which completely obviates any possible loss of gas. The paper's authors, Schultz, Decker and Corlew, were describing a 3 bpd. pilot plant in which it was necessary to recirculate a hydrogen-rich gas at pressures up to 750 psig. It was necessary to operate the compressor so as to be both safe and leakproof. No hydrogen leakage could be tolerated through the shaft seals and packing glands, not alone because of the explosion hazard but also because even a small leak would prevent attainment of accurate material balances and data on yields.

The sketch above shows how this was done. A conventional low-pressure household refrigeration compressor driven by a totally enclosed motor is installed in a pressure housing with a single removable cover flange. The suction port of the compressor is connected through the vessel head direct to the inlet piping, with the discharge port open to the pressure housing. The compressor casing is thus subjected only to the differential operating pressure and not to the total recycle pressure. Furthermore, since the entire vessel is at discharge pressure, there is no leakage problem and conventional shaft seals can be used. There is, of course, no very difficult problem in sealing the necessary electrical leads.

Packed Joints Simplify Piping To Equipment in Place

TEH-SHI CHU, *Chemical Engineer, Taiwan Alkali Co., Kaohsiung, Formosa.*

When you have a piece of equipment such as a pump which is already in place, and must be piped up to existing piping, there is a pipe-fitting problem of some importance: (1) It may be hard to finish a nipple to the exact length needed for either a screwed or flanged connection. (2) Having got the right nipple, it is hard to insert a gasket between the flange faces in the last joint. (3) Finally, if both the problems mentioned have been solved, it is still possible to get into trouble due to strains if the pump is of brittle material such as high-silicon iron, glass or graphite.



The sketch shows three simple packed joints which I designed to overcome these various troubles. They can easily be fabricated in any shop having a common lathe, drilling and welding equipment. Sketch (a) shows a design for screwed pipe connections and (b) a comparable design for flanged connections. The sketch at (c) illustrates a design for use in graphite pipe.

Such joints will take care of moderate amounts of

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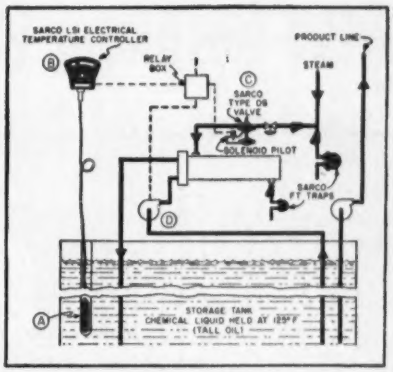


Making Tall Oil Behave

A nationally-known detergent manufacturer uses tall oil in one of its products. Stored in tanks and pumped to vats on upper floors, the liquid must be kept at 125° F to avoid damage to pumps and heat exchanger.

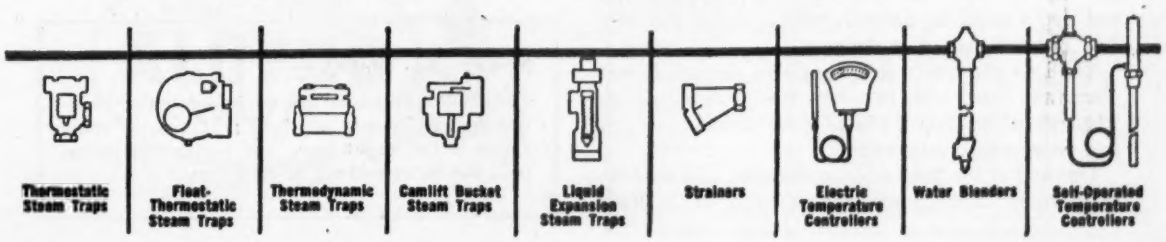
Until recently, the liquid was heated by an exchanger using hand control of the steam valve. This proved costly since it was almost impossible to keep the liquid at the desired temperature.

Sarco suggested the installation above. The Electric Temperature Controller (B) opens steam valve (C) and simultaneously starts pump (D) whenever temperature drops below 125° F.

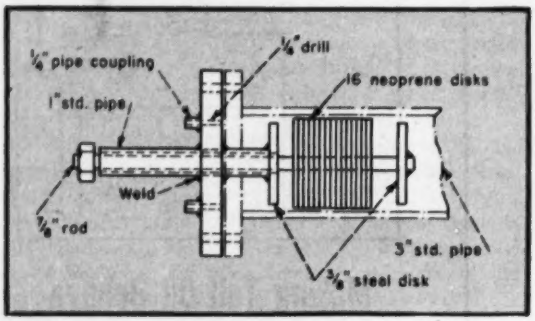
Result: shutdowns eliminated, product quality improved . . . another example of how Sarco engineering know-how helped solve a temperature control problem by proper use of steam. Write for Case History 119.

SARCO ELECTRIC TEMPERATURE CONTROLLER holds liquids to ± 1° F. Temperature setting may be easily changed by turning one small knob. Write for Bulletin 1025-A.

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS



thermal expansion, as well as bolting strains which might be harmful to equipment. Also they make it easy to disassemble pipe lines for inspection and repair. The exact design, with respect to number of packing rings and type of packing, will depend of course on the application but should not be difficult to decide in any particular case.



Better Way to Test Piping After Repairs

The trend to all-welded piping systems in modern industrial plants sometimes poses a maintenance problem when repairs become necessary. This is especially true in chemical plants, where the possibilities of fires or explosions make repairs by welding extremely hazardous.

At the Du Pont Co.'s neoprene plant in Louisville, Ky., repairs are made by sawing out defective sections of pipe and fitting screwed flanges to the remaining ends. The gap is then filled with a spool-shaped assembly consisting of a short piece of pipe similarly fitted with flanges.

When this method was first adopted, it raised the question of how repaired parts could be pressure-tested without clearing out and retesting the entire system. The spool-piece, in view of its portability, was easily tested before final assembly, but simple and economical testing of the newly flanged ends on old pipe was quite another matter.

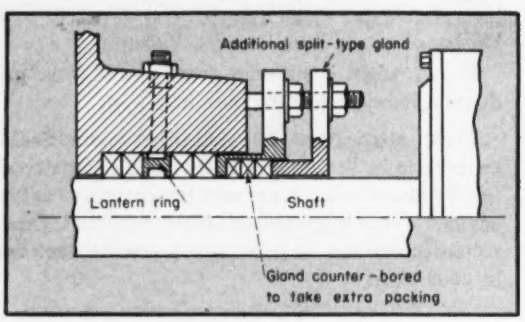
M. O. Abell, pipe-fitter foreman at the Louisville works, provided a neat answer in the testing device shown in the accompanying sketch. It consists of a 7½-in. diameter blank flange, bored at the center to fit over a short piece of 1-in. std. pipe. The pipe is welded to the flange, extending 5 in. on one side and 2 in. on the other. A ⅜-in. thick flange, slightly smaller in diameter than the pipe to be tested, is welded to the shorter end, and a matching flange is welded to one end of a ⅞-in. diameter rod 14 in. long.

The large connection flange is drilled through in two places and fitted with two ¼-in. steel pipe couplings. These are welded over the holes to accommodate air-line and pressure-gage connections.

One end of the flanged rod is threaded, and 16 disks of chemically-resistant neoprene are strung on it. Each disk is ¼ in. thick by 2⅛ in. in diameter, with a ⅞-in. hole through the center. The threaded end of the rod is passed through the 1-in. pipe so as to project from the longer end of the tube, and a ⅞-in. nut is then loosely applied to the threads.

To use the testing plug, the end with the string of disks is inserted into the pipe to be tested. The plug flange is tightly bolted to the pipe flange under test, with a suitable gasket between. When the nut on the protruding end of the plug rod is drawn up, the neoprene disks squeeze together and expand to a tight fit inside the pipe, sealing off the main part of the system. Air pressure is then applied to the cavity between the neoprene disks and the flange. When a satisfactory gage pressure is reached, the air valve is closed and the new work is tested for pressure tightness by soap-bubble technique.

The disks are made of neoprene to provide a much longer life under a broad range of exposure conditions than would be generally expected with ordinary types of rubber.



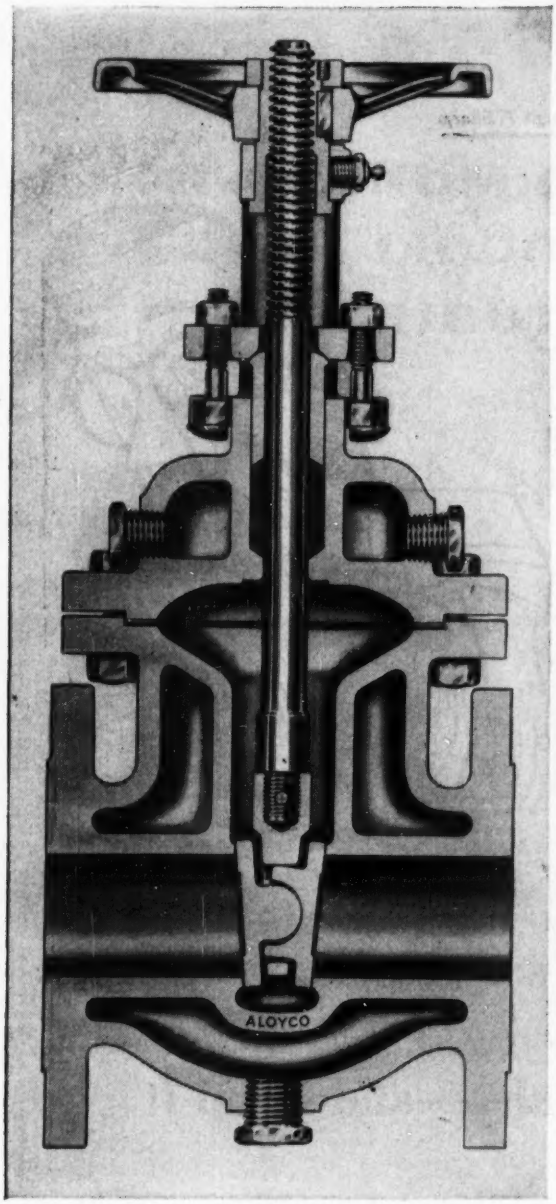
How to Get Extra Packing Into Pump Stuffing Box

K. D. Turnbull, *Assistant Engineer, Orrs Zinc White Ltd., Widnes, Lancs., England.*

In pumping slurries with a rotary positive-displacement pump of the Moyno type I found it necessary to have the stuffing box at the discharge or high-pressure end. This caused difficulty with leakage through the stuffing box after only a few day's operation. To overcome this problem I modified the stuffing box as shown in the sketch so as to take several extra rings of packing. The leakage was eliminated and the time between renewals of the packing was doubled.

Sorry to Delay—

Last month we promised that the answers to the "inner-tube linearity" puzzle (see April 1954, p. 230) would appear in the August issue. The promise was premature. But the answers will be along soon.



Cross-section shows how jackets extend to edge of flanges and include stuffing boxes on this Aloyco 1105 Jacketed Gate Valve. Also shown are the non-fouling, ball-and-socket split-wedge disc and mar-proof rocker-type gland plate and follower.

Now-

fully jacketed valves put the heat on slow-moving corrosives

Does your plant handle corrosive fluids that slow down or solidify under normal temperatures?

Then you're in line to benefit from the heat-holding design of Aloyco jacketed Gate, Globe and Check valves. Besides having all the Aloyco features shown at left, they're the only high alloy valves on the market to be *completely jacketed.*

They keep valves at higher temperature than steam tracing systems, and provide more uniform, less hazardous heating than thermal electric methods. You'll find them especially useful in line processing of rosin, resins, tars or tar oils, pthalic or maleic anhydrides, molten sulphur and other viscous liquids.

We'll be glad to arrange for a trial installation of Aloyco jacketed valves in your plant. Write the Aloyco Corrosion Engineering Service for further information. **Alloy Steel Products Company, Inc., 1301 West Elizabeth Ave., Linden, N.J.**

4.14

Fact-filled Bulletin No. 3 lists specifications and uses of Aloyco Jacketed Valves. Send coupon for your copy today.

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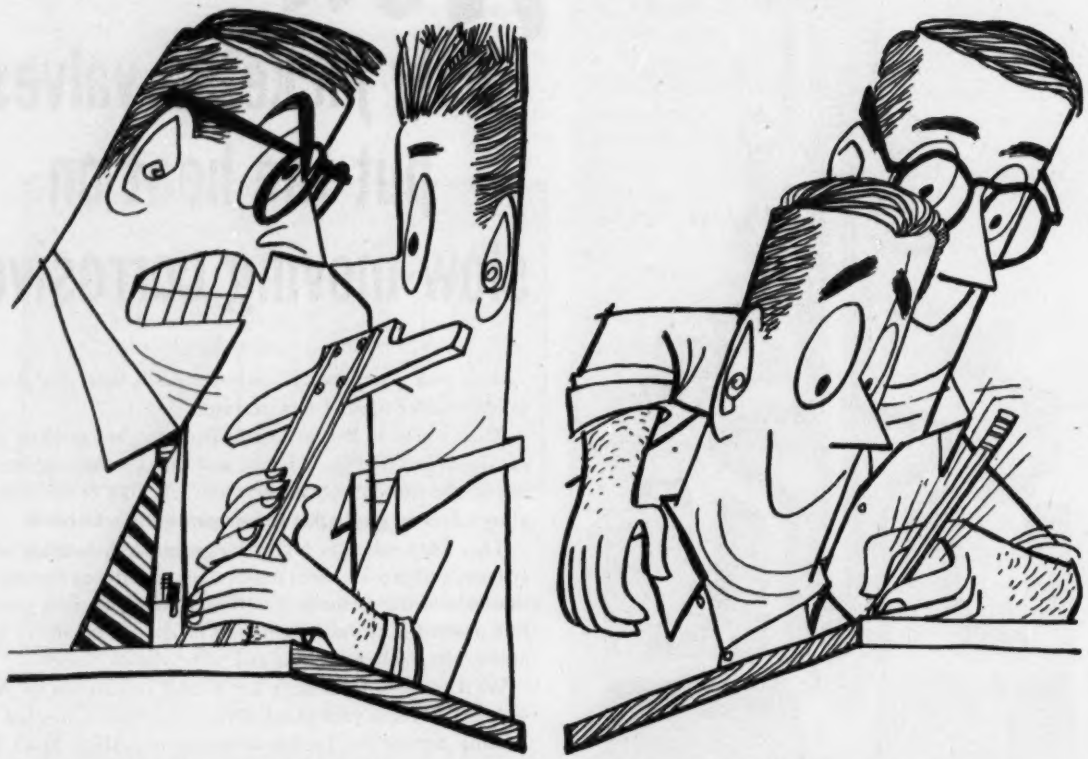

SLAVE-DRIVING and bossing won't do it, neither will . . .EXCESS PATERNALISM, but to lead you must first know. . .

HOW TO . . .

Win Your Workers' Loyalty—and Keep It

WESLEY H. HAMMOND

You and I are funny. We hike twenty miles lugging the hind end of a deer and call it fun. But tell us to walk two blocks on company property while some other joker rides in a company car and our day is ruined.

We work ten happy years for some slave-driving old-timer because we respect him. But put us under a brilliant young fellow who knows all the ins and outs of applying good industrial relations—and we look for another job.

Why do we do these illogical things? Simply because we behave like human beings and not like interchangeable squares on an organization chart. But, since human beings and not charts do the work, and, since human beings will exert only a half-hearted effort unless they have the will to work, let's look at a few ways to build the worker's loyalty and foster his will to work.

WESLEY H. HAMMOND *has been a civilian scientist for the U.S. Navy for 30-some years. He is now director of the Navy's Industrial Laboratory, San Francisco Naval Shipyard, Calif.*

NEXT MONTH . . .

Darn few people know anything at all about chemical engineers or chemical engineering. "Not surprising," you say. It isn't, but it isn't good either. And the solution to the problem falls right in your lap. Help, in the form of facts and figures on the situation and some tips, is on the way. Check next month's YOU AND YOUR JOB.

The Newcomer's Big Error

Too much administration. That's the most frequent mistake of the new administrator—who feels that

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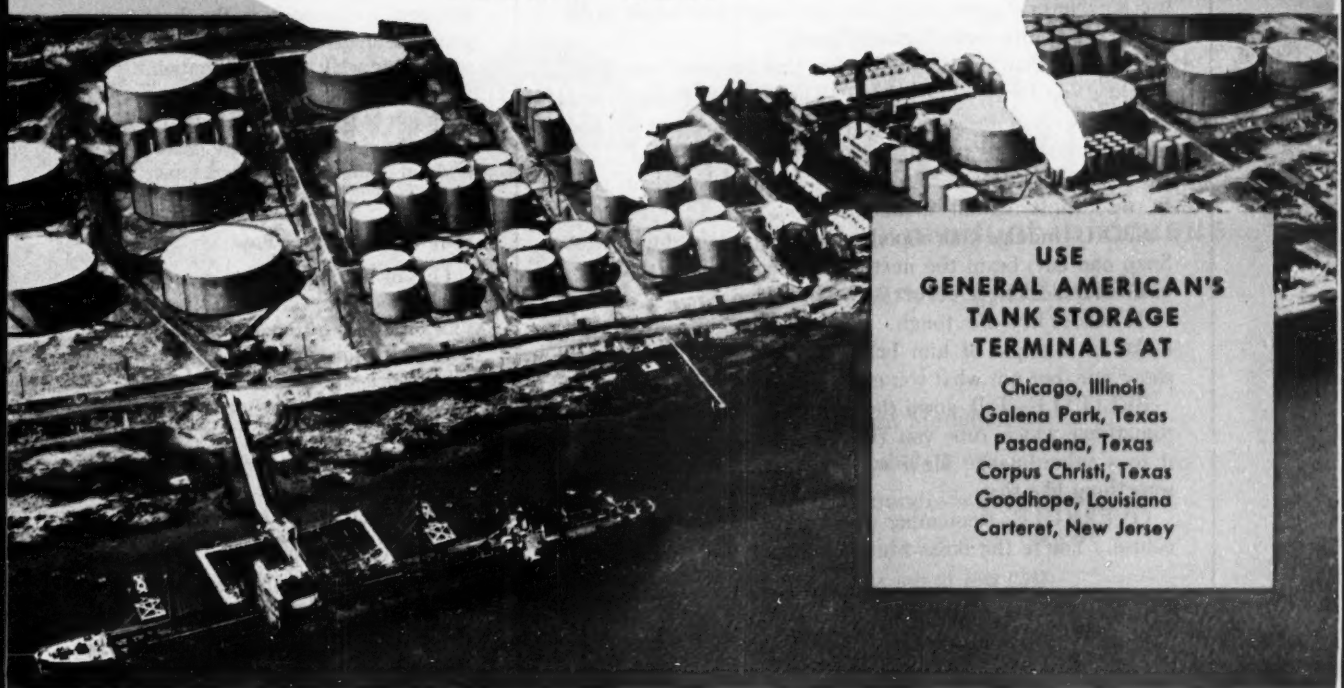

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Nine Tested Ways to Lose Your Workers' Respect

These nine methods are unconditionally guaranteed to help you lose the respect and loyalty of your subordinates. Check yourself and see how many you use.

NAG—Keep after your men. Don't let them "on their own" for a minute. If they resent this, let them know that it's for their own good—see if they care.

VACILLATE—Make changes continually. Change your mind, contradict orders, alter anything you can think of. If you do this enough everybody will get into the act—you'll have personnel changes galore.

BOSS—Rely strictly on authority. You have the authority, use it. Never suggest, never ask for suggestions—only order. You'll get results—not necessarily good.

FAVOR—Play favorites. The few that become "your boys" will love you for it. The others? They only work here—now.

SNEAK—Run the show on the QT. Better not let your people know what's going on around them. That's your concern, not theirs. Keep 'em in the dark. Let them come to you for information—if they dare.

SPOIL—Indulge your moods. After all, you're human too. Snap one day; beam the next. It'll keep them off balance—until they no longer bother with you.

THREATEN—Be tough. And if someone crosses you, make an example of him before his fellow-workers. You'll show 'em—but not what you expect.

BELITTLE—Talk down the company. If the "brass" does something which rubs you the wrong way, complain about it to a subordinate. He'll mark you as a "regular guy"—or something like that.

OVERRULE—Remember who's always right. You are, of course. You're the boss—who'd doubt YOU.

he has to make an early impression on "the brass?"

He barely dents the seat of his new chair before he spots all kinds of illogical work relationships which his predecessor had allowed to develop. First off, he notices that that impressive Ph. D., introduced as head of the engineering laboratory, is head of the lab in name only. Actually, the real head is a mere nobody who never went to college—but who's a natural-born executive and is tacitly allowed to lead the people.

There are other such examples. Throughout his organization he sees the straight lines of logical charting bent into corkscrews by the natural evolution of what Roethlisberger, Dickson and Wright[4] call the "informal organization." He observes abler men doing part of the charted work of other men and immediately wants to stop them, because he thinks that it is easier to change men than it is to change a chart. Such authorities as Viteles[5] who say: "I don't care how the organization looks. What I'm interested in is how it works," make no impression on him.

What Should He Do?

Faced with this situation, our newcomer to authority can do one of two things. He can give the administration an immediate horse-doctor's dose of upsetting changes. Or he can use a little horse-sense and go slowly on changes until he has thoroughly studied all aspects of the human situation.

The first plan will show quick paper results to "the brass." But the second is the only plan which will win the workers' loyalty.

Toy Brooms vs. Tom Jefferson

No one objects to a new broom if it is really needed. But a vigorously wielded toy broom kicks up a whale of a lot of dust, which then settles as grit into delicately adjusted human gearing.

Thomas Jefferson once said that the best government is the least government. The same rule applies remarkably well to administration, IF we admit to ourselves that the main job of a leader is to help the worker to do a better job, to take pride in doing it and to be happier in doing it.

Showing 'em Who's Boss

One of the best ways to convert loyalty and the will to work into sullenness is to be too dogmatic.

Actually, this poses a psychological paradox—because there is undoubtedly some built-in weakness in human beings which makes them blindly follow an impressive leader who pretends to know all the answers. They follow up to the time, that is, when they first catch him bluffing.

It is a great temptation to the new leader, first feeling the yeast of new command, to throw his weight around a bit. He writes crisp, arbitrary orders on the basis of armchair knowledge of what is happening down the line. He forms a "palace-guard" of favorites—like all dictators. He ignores the advice of such democratic sources of information as workers' councils and shop committees. And he takes special pride in showing who's boss.

Later, after he has autocratically demoted a few plain-spoken subordinates for reasons which he cannot explain even to himself, the poor psychology of his leadership begins to become pretty apparent. Eventually even his most loyal supporters will have to wake up to the fact that he cares so little for their physical, mental and emotional contribution to the output of the

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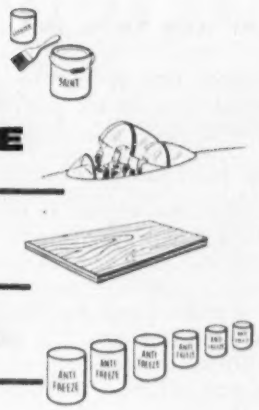

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company that, as far as he is concerned, they do not play on the team at all.

But Don't Lack Firmness

There is a lot more to this matter of learning how to avoid being dogmatic than the new administrator is likely to realize.

Workers expect the superior to be firm. But there is a world of difference between firmness—a trait of good leadership—and dogmatism—the obstinacy of an incapable man.

And your subordinates can recognize this difference.

Ring Down No Iron Curtain

Another rule to follow if you want to foster loyalty in subordinates is: Keep your administration open and above-board.

Few practices can kill cooperation as deftly as secret administration. This type of underground thinking and behind-the-scenes handling of workers is characteristic of a certain brand of management. Underlings soon realize that their affairs are being decided in the "bosses' lunchroom."

This destroys the will to work by setting up a wrong thesis, namely that management distrusts the worker. "If I am a partner on this team," asks the worker, "why not ask ME occasionally what I think is a faster and better way to do my job?"

Pass the Word Along

In his pamphlet "The Unwritten Laws of Engineering," King[3] catalogues raw deals. He lists: "Next to responsibility without authority . . . responsibility without information. . . . An excellent practice followed by many top-flight executives is to hold occasional meetings of section heads to acquaint them with major policies and developments in the business of the department and the company, so that all will know what is going on."

The importance of bringing administration out into the light of day applies not only to keeping minor engineering executives correctly informed, but applies equally well at all levels of the organization—of any organization, that is, which wants the intellectual and emotional loyalty of its workers.

If a subordinate is once allowed to become suspicious and distrustful of his boss, he is likely to pack up and take his experience to some other company.

Emotion Is a Top Obstacle

One of the toughest handicaps that a good worker is up against in trying to do his job is emotional administration. This is a style of management motivated by the prejudices, angers, fears and impulses of a mentally undisciplined boss. Such a boss has never learned that the leader who is watched and imitated by his subordinates must rigidly curb his emotions and virtually transform himself into an institution.

After all, your subordinates are only men, and men by nature are imitative. Therefore, your example will have a greater effect than reams of (probably unread) orders.

The leader who thus disciplines himself can establish harmony and build loyalty. The emotional administrator, on the other hand, tends to destroy what natural harmony already exists in the coordinated effort of his workers' informal organization.

A case in point occurred in a certain chemical company. A group leader in the engineering department, with a reputation for being a hard worker who had won and held the loyalty of his own small group of men, was suddenly and unexpectedly demoted.

Quiet inquiry by a personnel man unearthed the fact that "personality incompatibility" existed between him and the administrator who had demoted him. Further search discovered that the incompatibility began when this supervisor defended one of his men vigorously and successfully against an unjust charge brought against him by the administrator.

It is doubtful if any company is strong enough to retain within its official family an administrator who allows himself emotional luxuries of this kind—particularly at the expense of his subordinates.

Positive Approach Needed

While the four major faults described above are characteristic of the bad generalship which betrays workers and puts companies into trouble, the realistic approach to better administration is positive and not negative. Good administration is not a matter of drawing up a list of "don'ts:" It is a matter of finding deeper psychological leverages by which to win and hold the respect of men—the real investment of a company.

Since the location of powers such as these are found within the deeper recesses of character, it would be well for executives—present and future—to abandon pet management theories and charts, and spend more time with their men to learn at first hand how best to help the worker do a better job; and to learn how to use the powers of their office to brush away some of the thorny obstacles which hinder the workers from doing a better job.

REFERENCES

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2. Viteles, Maynard, et al., "Effective Formanship," p. 71, McGraw-Hill Book Co., N. Y.
3. King, "The Unwritten Laws of Engineering," p. 9, Reprinted in pamphlet form from *Mech. Eng.* for May, June and July, 1944.

THESE CAN HELP YOU

"The Technique of Handling People," Laird and Laird, McGraw-Hill Book Co., N. Y.
"How to Be a Successful Leader," Auren Uris, McGraw-Hill Book Co., N. Y.
"The Technique of Executive Leadership," James F. Bender, McGraw-Hill Book Co., N. Y.

READING SPEED

. . . *How Good Is Yours?*

Chances are you're a poor reader. "Engineers," says a report from Case Institute of Technology, "read unnecessarily slowly and inefficiently."

A survey of the reading patterns of engineers in industry by Case's Reading Laboratory has found that the average engineer spends about four and a half hours per day read-

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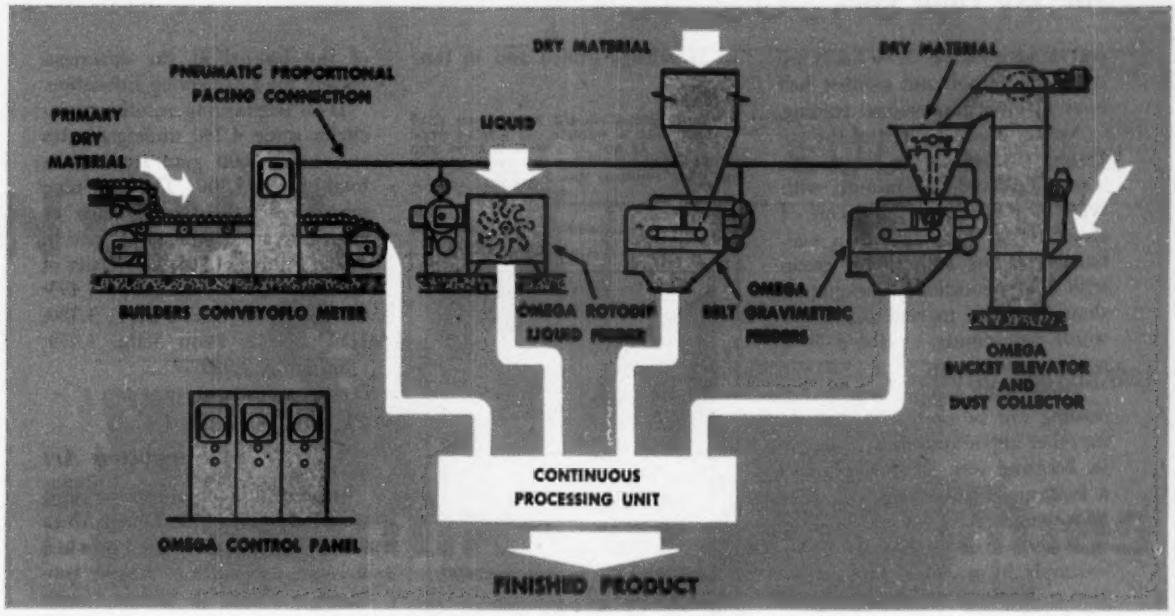

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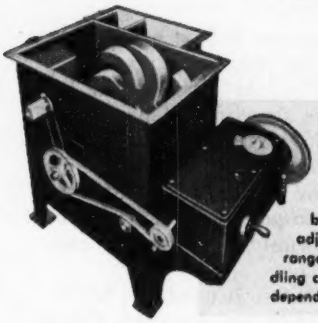

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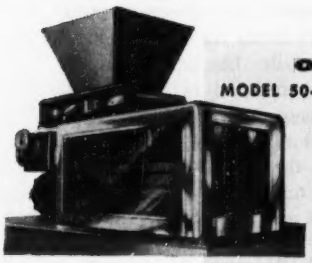

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ing, of which some three hours are spent on the job and another half hour involves professional reading.

Average reading speed of the engineers studied in the survey was about 260 words per minute, with an average comprehension score of about 68%. According to a well-known reading authority, a group with that educational background should be able to read about 500 words per minute, at above 70% comprehension.

Those three hours of on the job reading can be partially reclaimed for other important activities merely by boosting your reading speed to a level more in keeping with your background. And this can be done in the course of your usual reading—simply by paying a little attention to how you're reading, as well as what you're reading.

▶**How to Boost Your Speed**—Quickest way to hike your speed is to take two or three seconds to scan the material—before you start to read. Don't forget that the editor has put in all sorts of typographical helps to make the piece easier for you to read and comprehend. Checking these BEFORE you start will map the course of the article, and you'll be able to anticipate what the author is going to say. This makes for faster reading and better understanding.

Three other hints to help you up your reading speed are:

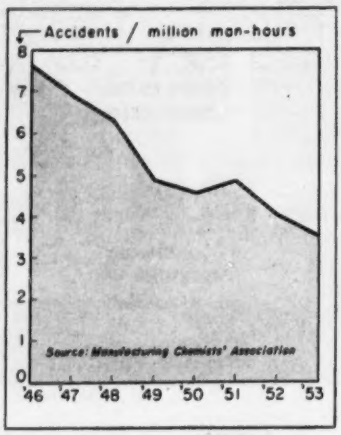
• Keep reading forward, don't go back and reread. If something is hazy, don't worry. It will probably be cleared up as you go on. If not, you can go back when you finish with a better background to understand what you had missed.

• Concentrate on ideas. Don't read every word. Spot the main thought in each sentence and go right on to the next.

• Group related words. Words have more meaning when grouped. For instance, the sentence, "The quickest way to increase your reading speed is to scan the material before you start to read," should be read, "Quickest way to increase . . . reading speed is . . . to scan . . . before you start."

Paying a little attention to how you read can pay big dividends both in knowledge gained and in time saved.*

* This piece should have been read in less than a minute. If you've done that, fine. If not . . . well, maybe you could profit by taking the pains to jack up your reading speed a bit.



FEWER ACCIDENTS
. . . Mark the Chemical Industry

Looking for a safe place to work? Get into plant work in the chemical industry.

In a chemical plant you'll be safer than you would be driving a car, puttering about the house or even just strolling down the street. That's the gist of a report recently issued by the Manufacturing Chemists Association.

The MCA report discloses that some 174 plants of 22 chemical companies operated throughout 1953 without having a single lost-time accident. And the overall industry record set a new low accident frequency rate of 3.69 per million man-hours worked—about 52% below the 1946 rate.

ENGINEERING ENROLLMENTS
. . . Topped by IIT

For the seventh straight year, more engineering students are enrolled at Illinois Institute of Technology in Chicago than in any other educational institution in the country. That's the finding chronicled in the 1954 yearbook edition of the Journal of the American Society for Engineering Education.

IIT's engineering enrollment includes some 4,740 undergraduates and nearly 600 grad students, a total of over 5,300. The next nine schools and their enrollments of engineers are: Brooklyn Polytech, 4,805; Purdue, 4,705; University of Illinois, 4,597; CCNY, 4,495; Georgia Tech, 3,669; MIT, 3,380; NYU, 3-218; Penn State, 3,059; Ohio State, 2,949.

PENMANSHIP
. . . A Forgotten Art

As the title of a popular song would indicate *Little Things Mean a Lot*. This is particularly true when it comes to numbers. Simply confusing a 3 with an 8, or a 1 with a 7, in a calculation can often spell the difference between a successful design and one that breaks down, or the difference between meeting a production schedule and missing it.

It appears to be a trend of the times that poor, sloppy penmanship is ever on the increase. The impressive abundance of typewriters, dictating machines, calculators, etc., that are the hallmark of the age have obscured the fact that the common pen or pencil is still the primary instrument of written communication.

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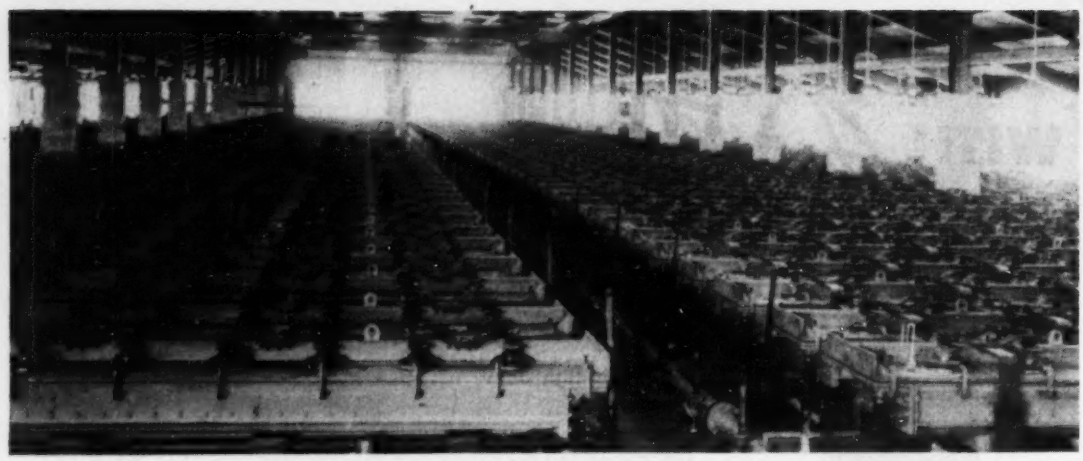


THESE MERCURY CELLS for the electrolytic production of chlorine and caustic soda are lined with hard natural rubber.

Natural Rubber, GR-S vs. Corrosion

Corrosion resistance and physical properties of these two types of rubber are similar. Their uses in chemical processing for both soft and hard forms are many.

J. P. McNAMEE

Natural rubber and the various types of synthetic rubber are unattacked by many chemicals which have a very corrosive action on metals. This chemical resistance is the basis for the widespread use of rubber products in corrosive environments.

Augmenting its chemical resistance, rubber possesses a combination of physical properties which makes it an extremely versatile and useful industrial material. Rubber can be molded into such forms as gaskets, diaphragms and hose—or combined with strong cord or fabrics to form conveyor and transmission belts. As hard rubber, its strength and rigidity allows it to be used as pipe, fittings and valves or as molded and fabricated items of all types. In sheet form, rubber can be applied to metal surfaces to protect the metal against attack by corrosive media.

The subject of rubber as a corrosion-resisting material is so extensive that it will be covered in several sections. The present article will discuss the properties and applications of natural rubber and type GR-S synthetic rubber. Other types of synthetic rubber will be considered in later sections. Although these articles will center around the use of rubber-lined steel as a material of construction in the chemical industry, the discussion of chemical and physical properties and the chemical resistance graphs will apply equally well to the other rubber items mentioned.

J. P. McNAMEE *is a chemical engineer with the U. S. Rubber Co., Providence, R. I.*

Processing of Rubber

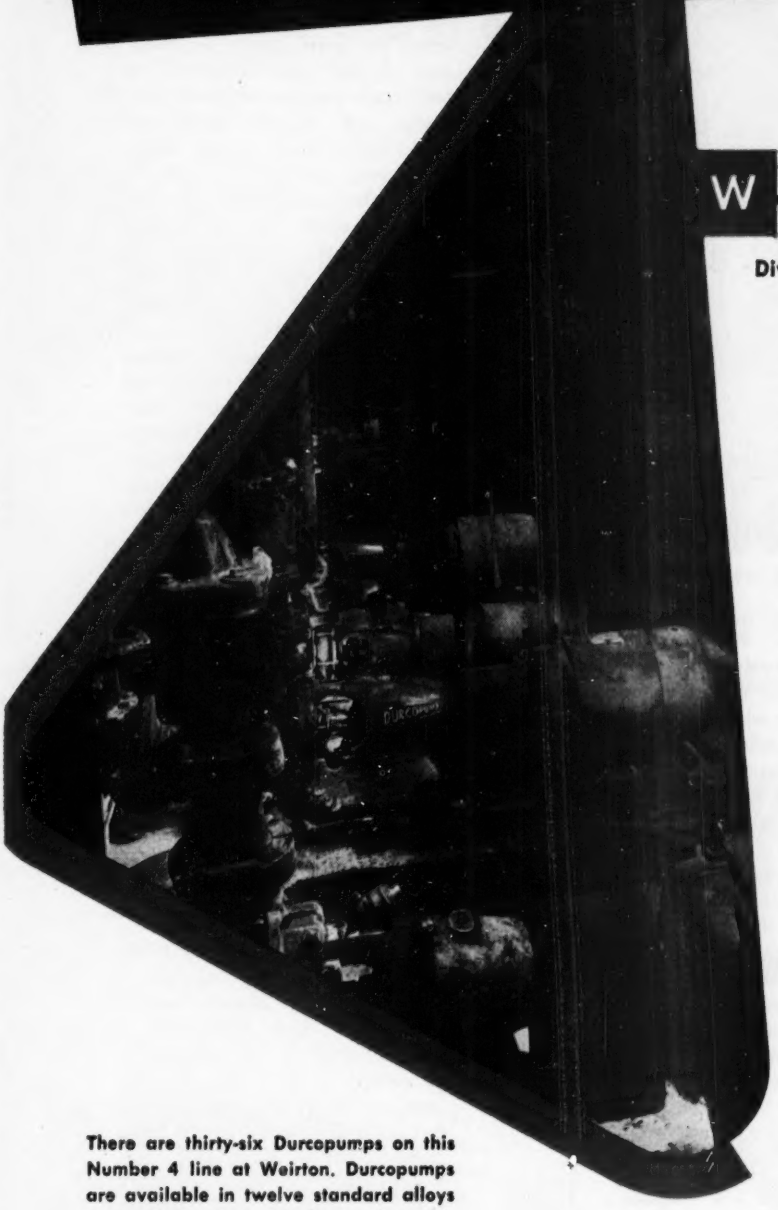
Natural rubber is an organic colloid obtained in a liquid form, called latex, from trees grown on plantations located principally in the tropical countries of southern Asia and the East Indies. Some latex is shipped in tankers to the United States and other manufacturing countries and is used in the liquid form for making certain special items.

By far the greater amount of latex, however, is converted to dry rubber on the plantations and shipped in bale form. This crude rubber, as it is called, is the basic raw material of the rubber industry and the starting point for the manufacture of rubber articles.

The rubber manufacturer must add to this crude rubber a number of different chemicals and then heat the entire mixture to bring out the properties desired in the finished rubber product.

Incorporation of these materials into crude rubber is known as compounding and the final mixture is a rubber compound or composition. Compounding is carried out in large internal Banbury mixers or on open roll mills. Following the compounding operation, rubber is prepared for fabrication into the finished item either by extrusion or calendering. A calender forms rubber into thin sheets which may be

DURCOPUMPS resist corrosion in electrolytic tinplate production at . . .



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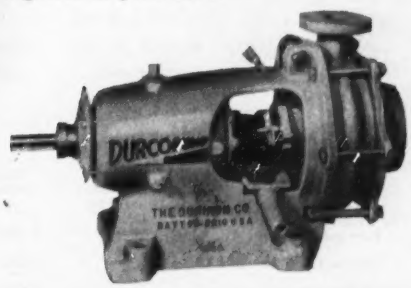

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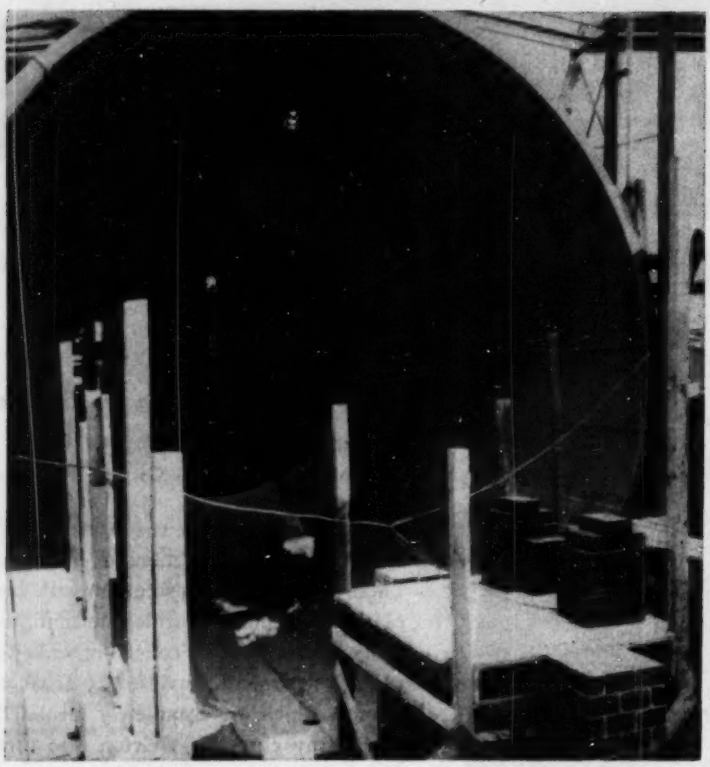

ACID VAPOR FLUME, 26 ft. in diameter by 115 ft. long, hard rubber lined.

combined to form any desired thickness.

The process of heating a rubber compound is called vulcanization or "curing." It usually takes place either in a mold under hydraulic pressure or in a steam pressure autoclave. The heat causes a chemical reaction to take place between the added chemicals and the crude rubber. Vulcanization changes the rubber from a soft plastic mass to an elastic material with considerably improved physical and chemical properties. In all but a few isolated applications, rubber is used in the form of vulcanized compounds.

Properties of Natural Rubber

The rubber manufacturer has a wide selection of ingredients to use in building compounds. By the proper choice and amount of added ingredients, desirable properties can be brought out and less desirable properties minimized. Specifications for rubber products are usually written around the physical and chemical properties of the vulcanized compound rather than its actual composition or the type of ingredients used in preparing it.

Rubber compounds may be classified, for easier consideration, into three hardness groups: soft, semi-hard and hard. The table shows the range of physical properties typical of compounds in each class.

Properties of Natural Rubber Compounds

Type Of Compound	Hardness Durometer	Tensile Strength, Psi.	Elongation, %	Maximum Operating Temperature
Soft rubber				
Pure gum	30–40 Type A	3,000–3,500	600–700	140 F.
Carbon Black Loaded	50–60 Type A	3,500–4,000	450–550	150 F.
Semi-Hard Rubber	85–90 Type A 45–55 Type D	2,000–2,500	20–40	180 F.
Hard Rubber (Ebonite)	65–70 Type D	8,000–10,000	1–4	200 F.

▶ **Soft Rubber**—The simplest rubber compound is the pure gum type. This term is rather specific and refers to compounds containing the lowest amount of added materials to obtain proper vulcanization. A pure gum compound has only small amounts of sulfur, zinc oxide and organic accelerators added to the crude rubber. These compounds are characterized by high resiliency and excellent resistance to certain types of abrasion. They are used as the inside layer in sandblast hose and as a sheet lining in pipe handling abrasive slurries.

Addition of carbon black to the basic pure gum compound produces a material with higher tensile and tear strength, better general chemical resistance and resistance to abrasion and wear. The rubber compounder can adjust these various properties to the desired degree by carefully choosing the type and quantity of carbon black.

The fine particle size carbon blacks made by the channel process reinforce rubber to the greatest extent. At the other extreme are the large particle size soft carbon blacks made by the thermal process. These soft blacks have very little reinforcing qualities and do not improve the physical properties of the rubber. The vast majority of industrial rubber items are made from carbon black filled compounds.

If a light colored product is desired, there are many white fillers available such as clay, barium sulphate and calcium silicate. None of these light colored fillers will reinforce rubber to the same extent as the hard carbon blacks. Practical compounds with good physical properties can, however, be made from these white fillers.

▶ **Semi-Hard Rubber**—Semi-hard rubber compounds have considerably better chemical resistance than soft rubber. The over-all physical properties of these materials are such that their application is limited to tank lining. A large proportion of the rubber used in tank

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lining work is in the form of semi-hard rubber.

Hardness of rubber may be increased by adding filler, as described above, or by increasing the sulfur content. Increasing the filler loading has only a slight effect on the chemical resistance. Increasing the sulfur content, on the other hand, greatly improves the resistance to chemicals including oils. For this reason, the semi-hard rubber compounds referred to in this article are understood to be of the high sulfur type.

▶ **Hard Rubber**—When the sulfur content of a rubber compound is increased as high as 30 to 35%, a true hard rubber or ebonite is obtained. In this range the rubber molecule is chemically saturated with sulfur and the vulcanized compound is a rigid material with excellent chemical resistance.

As in the case of soft and semi-hard rubbers, various modifying ingredients are added to the crude rubber, in addition to sulfur, to produce desirable characteristics in the vulcanized compound. For example, certain fillers and resins will decrease the inherent brittleness of hard rubber and allow its use for molded items of all types. Solid pipe, fittings and valves, made from hard rubber, are widely used in chemical plants.

Chemical Resistance of Natural Rubber

Vulcanized rubber compounds will resist a wide range of chemicals encountered in everyday industrial processes. Typical examples are:

- All concentrations of hydrochloric, acetic and phosphoric acids.
- Dilute sulfuric acid.
- Saturated salt solutions such as alum and ferric chloride.
- Acid and basic bleach solutions.
- Chlorinated brine and wet chlorine gas.
- Plating solutions.

Rubber as rapidly attacked by:

- Strong oxidizing acids such as nitric and chromic, as well as concentrated sulfuric acid.
- Aliphatic, aromatic and chlorinated hydrocarbon solvents.

When a rubber compound is exposed to a chemical environment it will either be entirely unaffected or will undergo one of the following reactions:

- Rapid surface attack, either hardening or softening, with no further effect on the rubber.
- Hardening of the rubber with a loss of physical properties and eventual failure of the material.
- Swelling of the rubber followed by a loss of physical properties and complete deterioration.

Rate of the three reactions will depend on the nature and concentration of the chemical media and the exposure temperature. Under certain conditions, the attack may be so slight that a rubber product will give satisfactory service over a period of many years.

Rate of chemical attack on rubber cannot be stated as a constant figure such as the conventional inches per year corrosion rate for metals. Experience has shown, however, that laboratory or field service tests carried out for a period of one to six months will give a practical indication of the suitability of a rubber compound. Such tests must be designed so as to include any physical complications inherent in the service such as solution turbulence, high liquid flow rate or abrasion. Traces of contaminating chemicals, particularly solvents, should be carefully considered.

Chemical resistance of rubber improves as the amount of sulfur combined in the compound is increased. For this reason semi-hard and hard rubber will resist stronger acid concentration at higher temperatures than soft rubber. Too, semi-hard and hard rubber will completely resist several chemicals which rapidly attack soft rubber. The chemical resistance of semi-hard and hard rubber is so similar that throughout the remainder of this article, the term hard rubber will be used to cover both types.

Rubber Tank Lining

Natural rubber-lined steel is an important material of construction in the chemical industry. The rubber is used as a $\frac{1}{8}$ to $\frac{1}{4}$ in. protective lining in storage and process equipment of all types, tank cars, pipe, fittings, valves and blowers. Either soft, semi-hard or hard rubber may be used, depending on the chemical and mechanical conditions involved in the particular service.

All three forms of rubber linings are applied as unvulcanized, homogeneous sheets, to steel surfaces which have been shotblasted and coated with special adhesives. In the unvulcanized form, the rubber sheet is plastic and will conform to complicated metal shapes. After the rubber is in place the entire unit is heated to vulcanize the rubber into its final form. This heating may be done in a steam pres-

INDEX

For your information and convenience, here is a tabulation of the materials of construction which have been covered thus far in the current Corrosion Forum series:

Aluminum	May 1952
Asphaltic Mastics	May 1954
Carbon & Graphite	Sept. 1953
Cast High Alloys	Oct. 1953
Chlorimet 2	Feb. 1954
Chlorimet 3	Mar. 1954
Durimet 20—Carpenter 20	Dec. 1953
Epoxies	Apr. 1954
Furane Cements	Dec. 1951
Glassed Steel	Mar. 1953
Hastelloys C, B & D	June-Aug. 1952
High Impact Styrene	Jan. 1953
High Silicon Iron	Jan. 1954
Lead & Lead Alloys	Feb. 1953
Natural Rubber, GR-S	Aug. 1954
Phenolic Cements	Jan. 1952
Polyethylene	Oct. 1952
Polytrifluoro-chloroethylene	June 1954
Reinforced Polyesters	Dec. 1952
Saran	July 1954
Silicate Cements	Mar. 1952
Stainless Steels	Apr.-Aug. 1953
Sulphur Cements	Feb. 1952
Tantalum	Apr. 1952
Unplasticized PVC	Nov. 1952
Worthite	Nov. 1953
Zirconium	Sept. 1953

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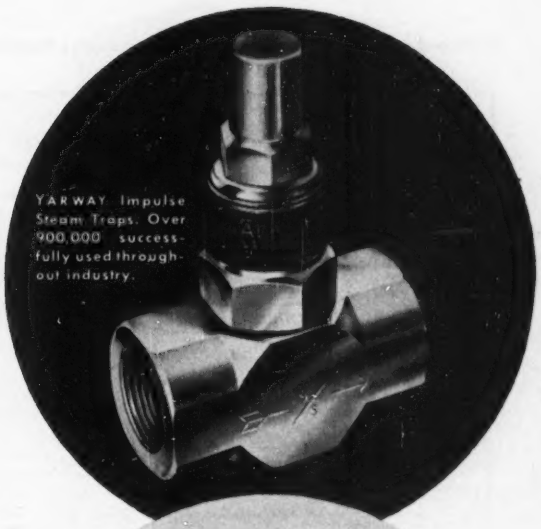

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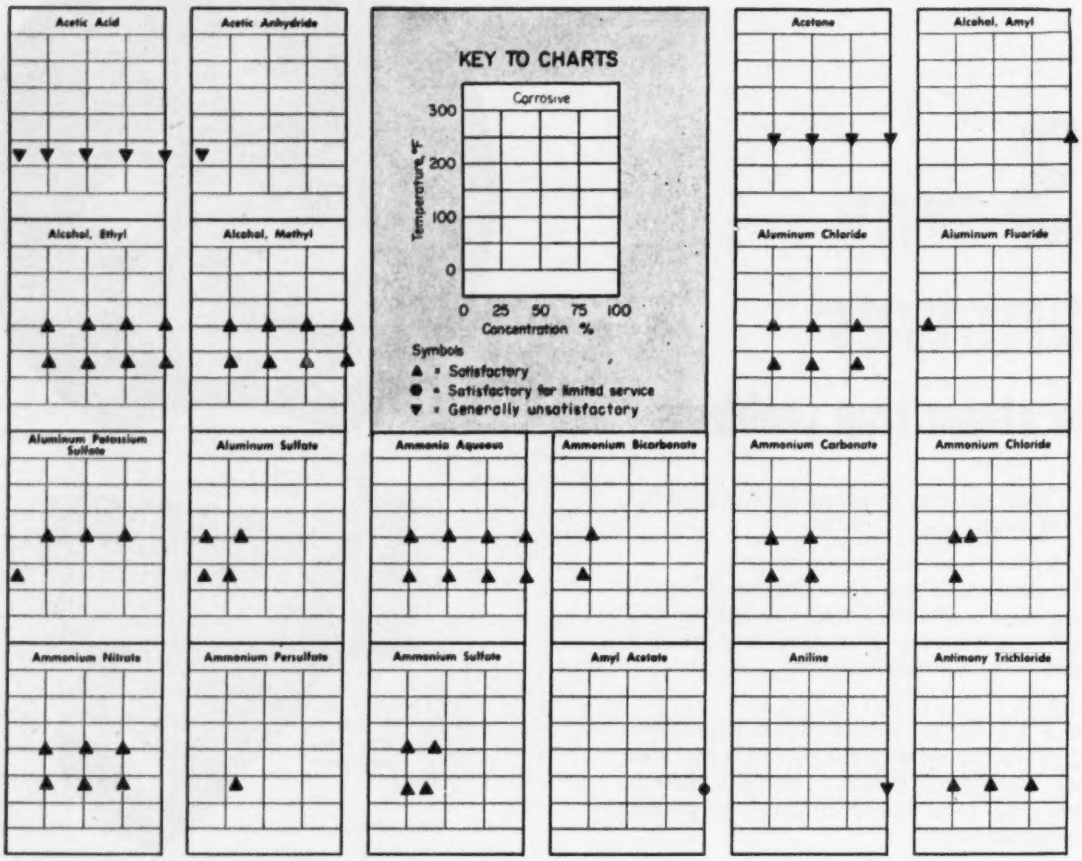
Corrosion Resistance of Soft Rubber (Natural and GR-S)



sure autoclave, or by atmospheric steam or hot water.

Applications of Natural Rubber

A number of specific chemical services in which natural rubber is being successfully used, will now be considered.

▶ **Hydrochloric Acid**–Rubber will resist all concentrations of hydrochloric acid up to 37%. As a result, it is widely used as a tank lining for storage and transportation equipment as well as for hose and gaskets to handle this acid. Approximate temperature limitations for 37% hydrochloric acid are 140 F. with soft rubber and 180 F. with semi-hard and hard rubber.

When strong hydrochloric acid contacts soft rubber it will rapidly attack the surface and form a tough film of rubber hydrochloride. This film prevents further penetration of acid and protects the rubber underneath from further attack. If this film is undisturbed, soft rubber may be used in contact with this acid for many years.

If the film is broken, as for example by flexing, the acid can penetrate further into the interior of the rubber. For this reason, rubber articles which are subject to various types of mechanical action cannot be used in hydrochloric acid service as long as, for example, a rubber lined storage tank. The surface of hard rubber is attacked at a very slow rate by hydrochloric acid and may be used in contact with it for long periods.

Properly-compounded rubber will not discolor water-white hydrochloric acid–even when it is stored in a lined tank for long periods.

▶ **Acetic Acid**–Soft rubber is rapidly attacked by all concentrations of acetic acid above 5%.

Hard rubber is resistant to all concentrations of acetic acid and may be used in contact with glacial acid at temperatures as high as 150 F.

▶ **Phosphoric Acid**–Both soft and hard rubber are unaffected by all concentrations of phosphoric acid up to 150 F. for soft rubber and 180 F. for hard rubber. Rubber products–particularly hose, valve diagrams, and tank linings–are used in contact with good grade phosphoric acid. The rubber must be carefully compounded so as not to add color or taste to the acid.

Hard rubber-lined steel has proved to be a practical, economical material of construction for use in triple superphosphate manufacturing operations. Acid concentrator towers, storage equipment and process piping lined with hard rubber have been in service for years.

▶ **Sulfuric Acid**–Soft rubber can be used in contact with sulfuric acid

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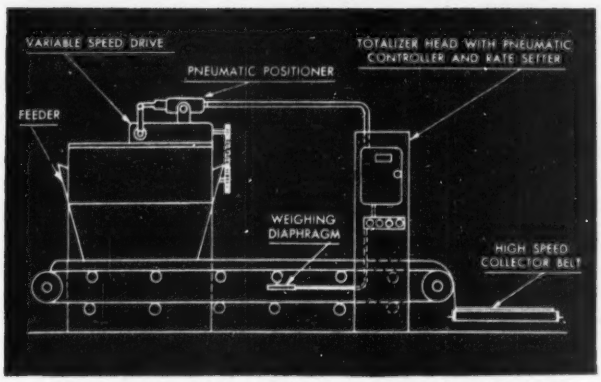

Typical Conveyoflo installation showing Model CFAB-T Conveyoflo Meter controlling flow of tobacco in automatic blending process. Conveyoflo employs pneumatic controller to automatically control feeder output within very narrow tolerances.

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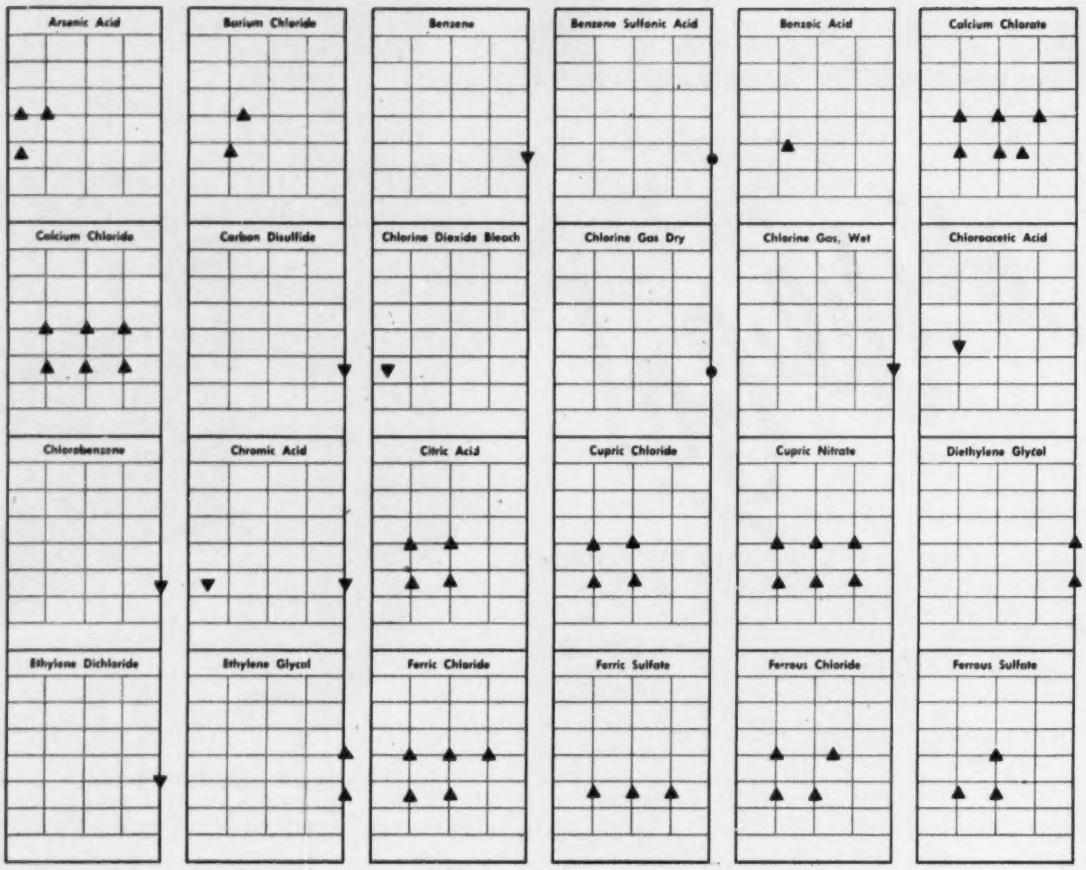
Corrosion Resistance of Soft Rubber (Natural and GR-S)



as strong as 40% at 120 F. Hard rubber will resist 50% acid at 150 F. Either soft or hard rubber is used to line pickle tanks used in the metal processing industry.

In applications of this type, one or two courses of acid-proof brick is used over the rubber. The brick protects the rubber from mechanical damage and decreases the temperature of the rubber. On the other hand, the rubber protects the metal from attack by acid which may seep through crevices in the jointing cement.

Hard rubber-lined pipe is extensively used in drain piping systems connected to metal pickle equipment. Hard rubber-lined covers and duct work are used with automatic equipment for the cleaning of metals.

▶**Chlorine**–Wet or dry chlorine gas, chlorinated brine and chlorine water solutions will attack soft rubber to form a chlorinated rubber layer on the surface. This is a hard brittle film which cracks easily allowing chlorine to attack the rubber underneath. As a result, soft natural rubber deteriorates rapidly in chlorine service.

Hard rubber is attacked in a similar manner but the chlorinated rubber layer forms as a powdery deposit on the surface. Even in strong chlorine solutions or atmospheres, this deposit builds up slowly enough to allow hard rubber to be used in these services.

Special types of hard rubber have recently been made available which are practically unattacked by chlorine. These compounds are being used as sheet linings for protecting equipment used in the manufacture of chlorine by the mercury cell process.

▶**Bleach Solutions**–Soft and hard rubber compounds can be used with sodium and calcium hypochlorite bleach solutions. Sheet rubber linings are used in make-up tanks, storage tanks and transport tanks. Rubber-lined pipe and pumps as well as rubber hose will handle these materials.

▶**Plating Solutions**–Hard rubber will resist all types of plating solutions except chrome. Hard rubber-lined steel tanks are standard equipment particularly for nickel plating. In plating work attention must be paid to the ingredients used in the compound. Materials which will leach out of the rubber and poison the plating solution must be carefully avoided. All rubber products to be used in contact with plating solutions should be carefully tested in the actual solution to make certain that no later difficulties will develop.

▶**Pulp and Paper**–A considerable number of rubber items are used

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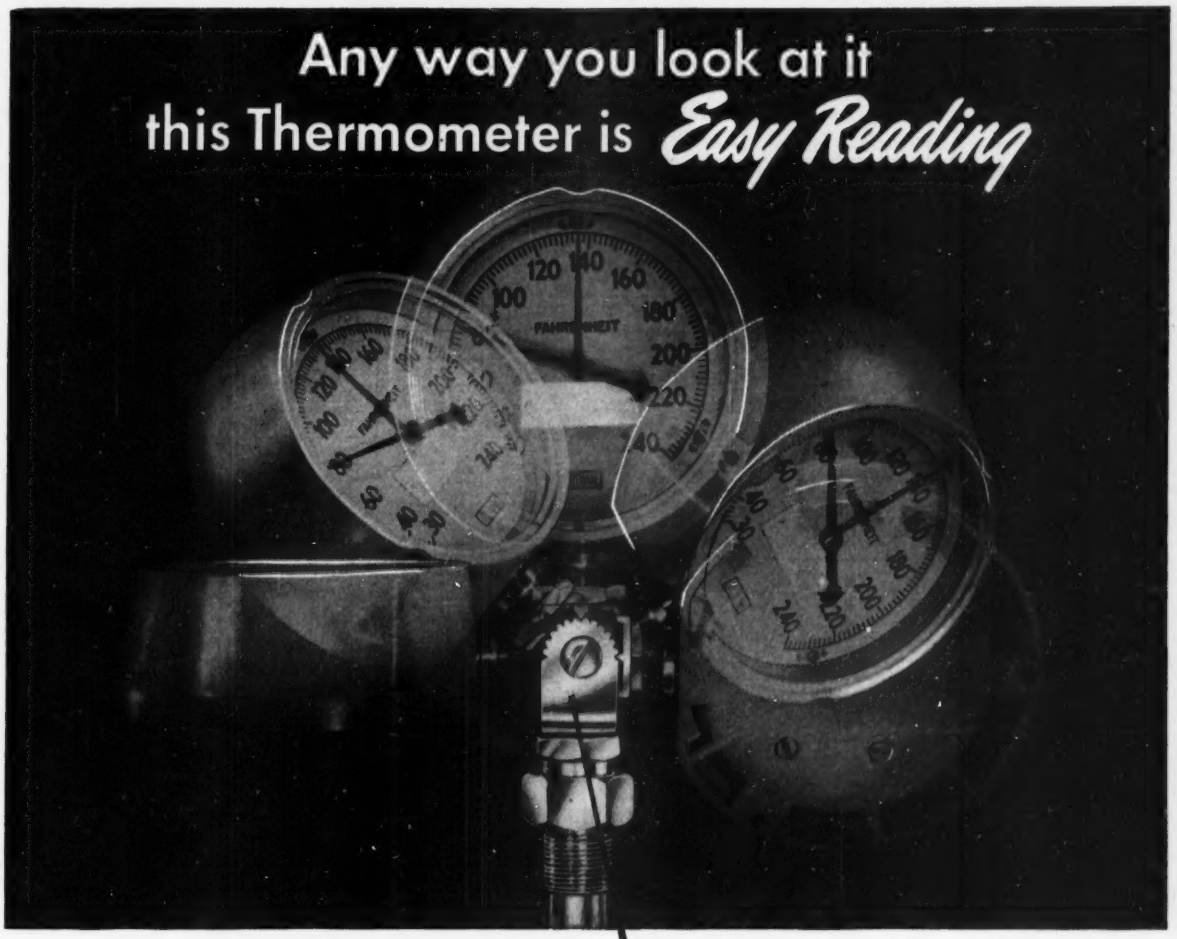

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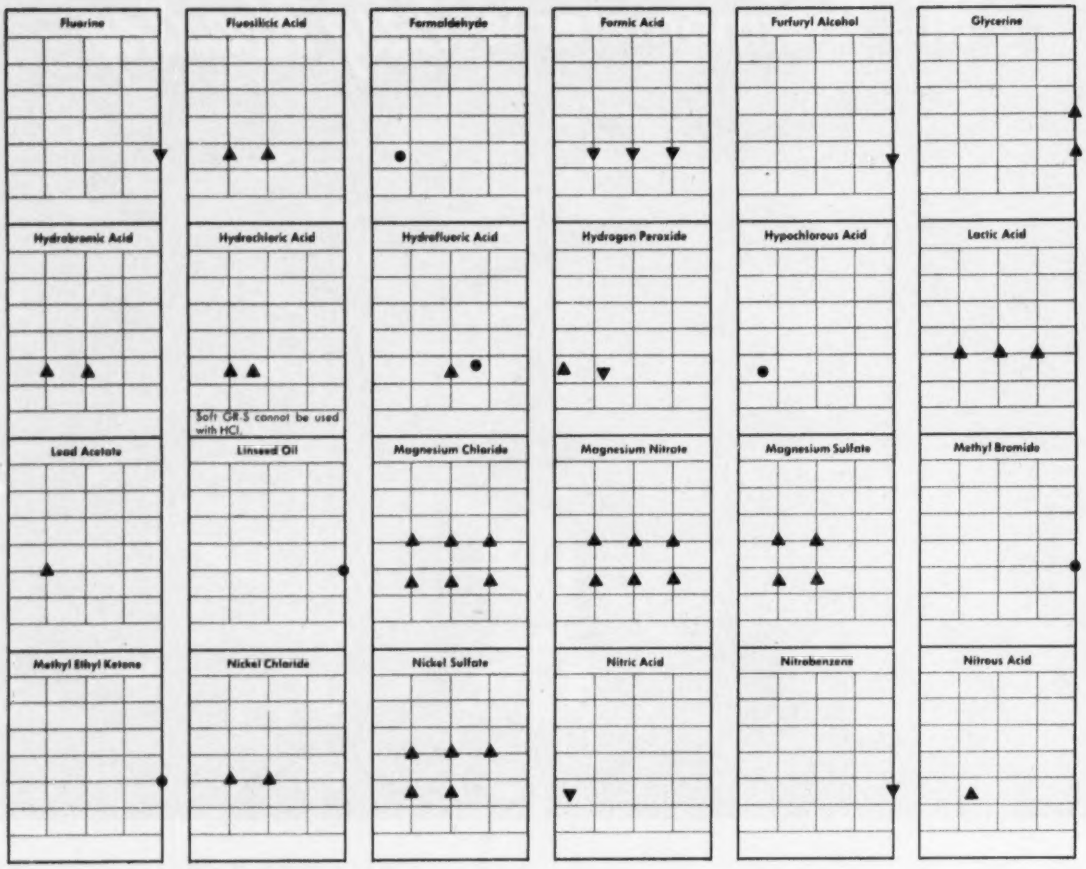
Corrosion Resistance of Soft Rubber (Natural and GR-S)



throughout the pulp and paper industry. Rubber-lined steel is used in the bleach plant for both chlorine solutions and hypochlorite bleach solutions. Rotary vacuum filters used to wash the pulp between bleaching stages are lined and covered with hard rubber. In addition, they contain hard rubber ribs to support the filter screen.

▶**High Temperature Service**—Although the temperature limitation for rubber is usually stated as 140 F. for soft rubber and 180 F. for hard rubber, there are heat-resisting compounds available which may be used at much higher temperatures.

Soft rubber which has been compounded for maximum heat resistance may be used continuously at temperatures as high as 200 F. Heat-resisting hard rubber compounds are being used as tank linings at continuous temperatures as high as 230 F. Not only the maximum temperature of an installation but the chemical agents involved should be considered whenever a higher than normal temperature is involved.

▶**Abrasion Service**—A very useful application of rubber, particularly sheet rubber-covered metal, is in contact with an acid vapor containing abrasive solids.

Rubber-covered fan blades and housings do a remarkable job of handling materials of this type. Rubber-covered fans will outlast unprotected metal fans many times and are more than worth the extra initial cost.

The above illustrations of natural rubber in the chemical industry are but a few of the hundreds which could be described. They are representative cases, however, and tend to illustrate some of the uses of this versatile material.

GR-S Type Synthetic Rubber

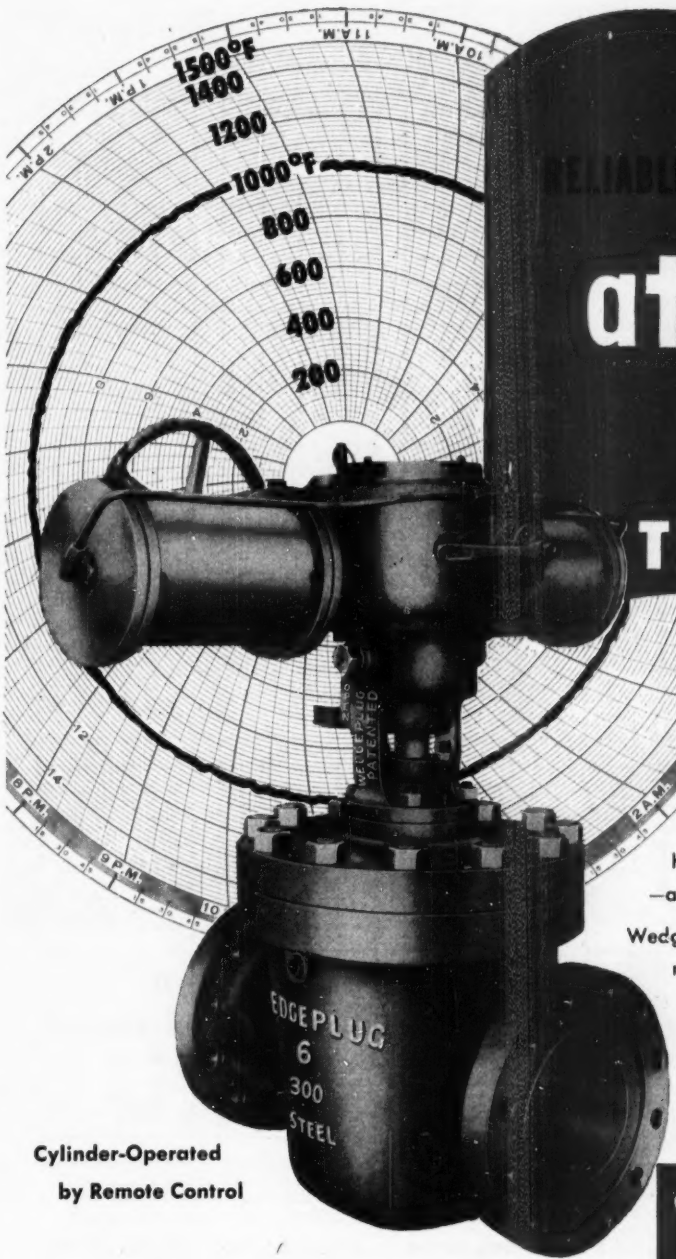
There are five basic types of synthetic rubber available in the United States. They are designated at butyl GR-S, neoprene, nitrile and Thiokol. Type GR-S is considered to be the all-purpose synthetic and accounts for approximately 80% of all the synthetic rubber produced in the United States. Its general physical and chemical properties are like natural rubber.

GR-S is made by the copolymerization of butadiene and styrene with the addition of modifying ingredients. The raw GR-S is purchased by rubber manufacturers who add compounding ingredients to obtain the desired finished properties. It is compounded in much the same manner as natural rubber and can be vulcanized to either the soft, semi-hard or hard forms.

GR-S is processed with the same

RELIABLE PERFORMANCE

at high TEMPERATURE



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Wedgeplug Valves made of Carbon Steel are recommended for temperatures up to 1000° F. When special metals are used, up to 1500° F.

The tapered plug lifts, turns, and re-seats in one operation. The raised seats are protected in both the open and closed position.

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STEEL DRY PLUG VALVES

Opening and closing time of the remote control, cylinder-operated valve illustrated can be adjusted to suit varied service conditions.

Can be supplied: wrench-operated; handwheel-operated; worm gear-operated. Adapted for remote control thru use of electric, air motor, or air cylinder operator.

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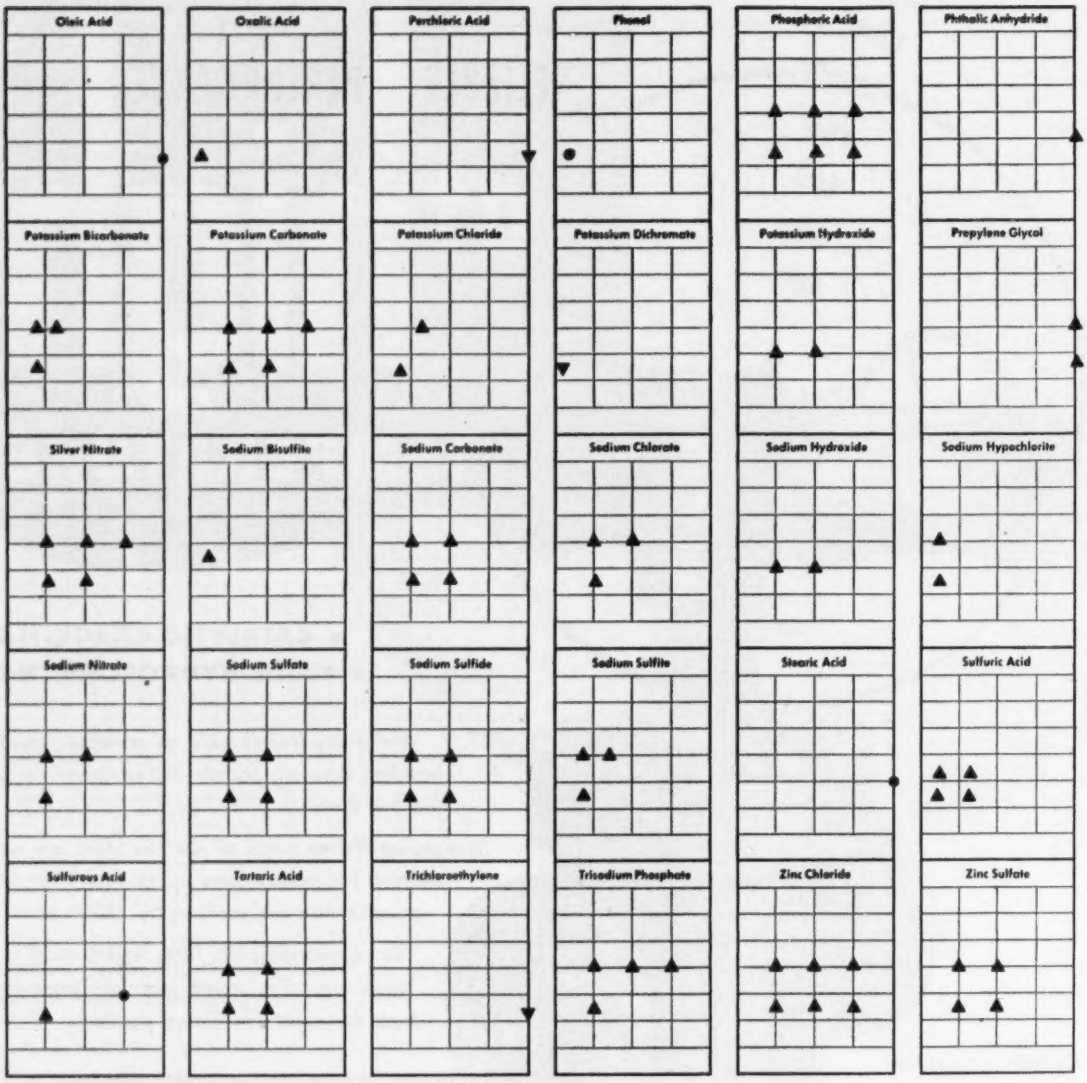
Corrosion Resistance of Soft Rubber (Natural and GR-S)



equipment as natural rubber and in much the same way. Since raw GR-S is a man-made product, as opposed to natural rubber which is obtained from a tree, its composition may be changed to bring out specific properties. As a result there are some forty varieties of raw GR-S available to the rubber manufacturer.

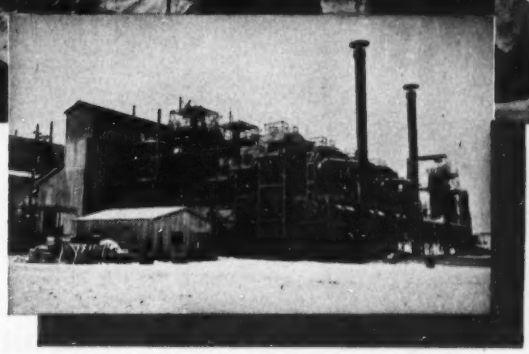
Chemical Resistance of GR-S

Soft and hard GR-S compounds are very similar to natural rubber in chemical resistance. The graphs for soft and hard natural rubber will serve as a guide for the same forms of GR-S in all cases except soft GR-S in contact with hydrochloric acid.

It was pointed out in a previous section that hydrochloric acid formed a surface film of rubber hydrochloride on the surface of soft rubber and once this film formed, it prevented further penetration of acid. This surface film does not form on soft GR-S, however, and as a result, hydrchloric acid will very slowly penetrate the entire thickness of the rubber. For this reason, soft GR-S cannot be used in contact with hydrochloric acid. This deficiency is not present in hard GR-S and it has about the same resistance to hydrochloric acid as hard natural rubber.

Chemical Resistance Graphs

The accompanying chemical resistance graphs have been divided into two groups. The first, and largest group, contains the information on soft natural rubber. Since hard rubber is resistant to some chemicals which rapidly attack soft rubber, a second group has been included to cover cases of this type. The reader should understand that hard rubber will also resist all chemicals which do not attack soft



Anaconda First to Roast Low Grade Sulfur Ore to produce SO_2 for Acid Manufacture

The world's first commercial installation for producing SO_2 gas from low grade sulfur ore, is now on stream at Anaconda Copper Company's plant at Weed Heights, Nevada.

The FluoSolids System that makes this possible includes four 18 ft. dia. Reactors plus other Dorr and auxiliary equipment. SO_2 gas is sent to a 450 TPD contact acid plant which supplies all acid requirements for leaching 11,000 tons of copper ore per day.

Feed to the system is 650 to 750 tons per day and gas production 26,000 to 30,000 C.F.M. Gas strength averages 8 to 12% representing a sulfur recovery of 98%. Unusual? Yes, because this is the first time that low grade sulfur ore could be recovered as SO_2 . . . economically. Here's how the system works . . . ore averaging 28% total sulfur is crushed to 10 mesh and fed dry to the Reactors which operate in parallel. Once ignition temperature is reached no extraneous fuel is needed. Ore is simply fed in at the design rate, latent heat in the bed immediately brings it to ignition temperature, and the fluidizing air oxidizes the sulfur to SO_2. Shutting down is a matter of minutes. And because the fluid bed stores sufficient heat, roasting can be started again after as much as 72 hours without adding additional fuel.

If you would like more information of FluoSolids . . . the most significant advance in roasting technique in the last 30 years . . . write The Dorr Company, Stamford, Conn., or *in Canada*, The Dorr Company, 26 St. Clair Avenue, East, Toronto 5.

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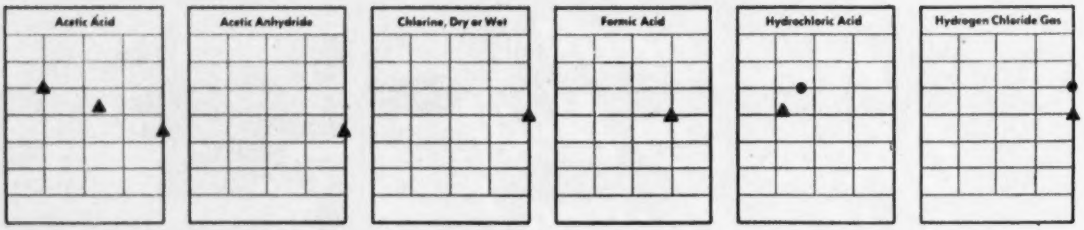
Corrosion Resistance of Hard Rubber* (Natural and GR-S)

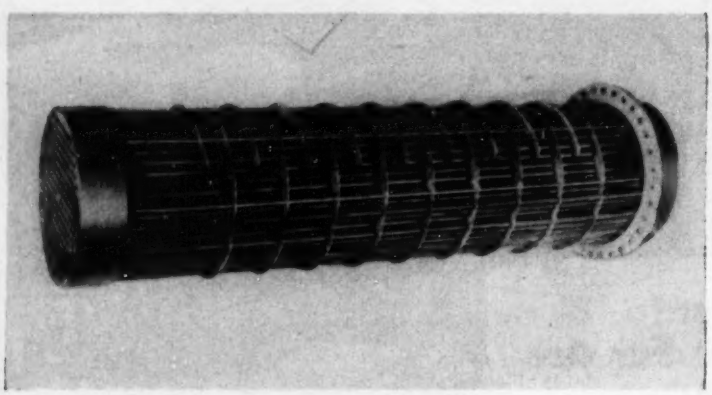


* Hard rubber will also resist all corrosives which do not attack soft rubber.

rubber. In addition, the increased temperature and chemical resistance of hard rubber will, in general, allow it to withstand these same chemicals up to 180 F.

The chemical resistance of type GR-S synthetic rubber, both the soft and hard varieties, is so similar to natural rubber that the information in these graphs may also be used for GR-S. The outstanding exception to this rule is in the case of hydrochloric acid attack on soft GR-S mentioned.

The information in these graphs is based on service experience with rubber-lined steel. It should be used only as a guide, however, in deciding on the suitability of natural rubber to handle a particular service. It is always best to run actual or simulated service tests before finally deciding to use rubber.



Resinless Impervious Graphite

Graphite Specialties Corp., Niagara Falls, N. Y., announces a new type of graphite which overcomes the limitations imposed by the addition of resins to make it impervious.

The new material, trade-marked Graph-I-Tite, is made impervious by filling the graphite pores with carbon itself so that the finished product contains only carbon. Results are greatly improved resistances to heat and attack by various corrosives.

Just announced, the material has been in existence for about a year. To date it has been used in tube and shell heat exchangers, cascade coolers, pipe and fittings, crucibles, and miscellaneous machined specialties.

Actual performance records are not available at this time.

Typical Properties

	Type A	Type G
Apparent density, lb./ft.^{3}	118	115
Tensile strength, psi	2,600	2,500
Compressive strength, psi	9,000	8,500
Transverse strength, psi	4,800	4,400
Modulus of elasticity ($\times 10^6$)	21	18
Thermal expansion, in./in./°F. $\times 10^{-7}$	11	9
Electrical resistance, ohm-in	0.00042	0.00035
Thermal conductivity, Btu./sq. in./°F./hr./in.	1,000	1,100
Maximum temperature resistance	1,300 F.	5,700 F.

New Process Plates Nickel Directly on Aluminum

Development of a process for applying nickel directly to either raw or anodized aluminum, to afford an erosion-resistant surface and materially strengthen the aluminum, has been announced by Bart Laboratories Co., Belleville, N. J.

The new electroplating process solves a major problem in coating aluminum with nickel by eliminating the need for an intermediate bonding material, such as copper or adhesive cements, and establishes a bond previously considered impossible.

Even very thin deposits of nickel over the aluminum provide a surface that is resistant to erosion, pitting, gouging and corrosion. When deposited to both surfaces of aluminum sheets, the nickel deposit greatly strengthens the aluminum without materially increasing the weight. Intricate designs and shapes, such as castings, can be given uniform and accurate protection of both interior and exterior.

With the new Alni-Clad process, a stress-free, ductile and pore-free surface can be applied in any required thickness. The material produced can be sheared, bent or fabricated. Because of the tenacious bond, it is not subject to separation even at high temperatures.

what's the **ONE BEST** answer to your problem of...

...GRANULATING?

A rotary knife cutter is probably your *one best* answer to granulating problems. It usually produces particles of more uniform size than are obtainable through any other type of machine. On the other hand, Sprout-Waldron has sometimes used roller mills with proper combinations of roll corrugations and speed differentials for this task. The attrition mill often offers the most flexible and economical means of granulating because disc surface, speed of rotation, clearance between surfaces, and feed rate can be varied. And a crusher might be the answer if the material is somewhat friable and the end-product size justifies it.

The nature of the material and the end product desired determine the proper machine to use with the least possible cost. Perhaps in no other operation is experience so important. The control of particle size in a finished ground product and the holding of extreme fines to a minimum are fields in which Sprout-Waldron has had unlimited experience.

...DEFIBERIZING?

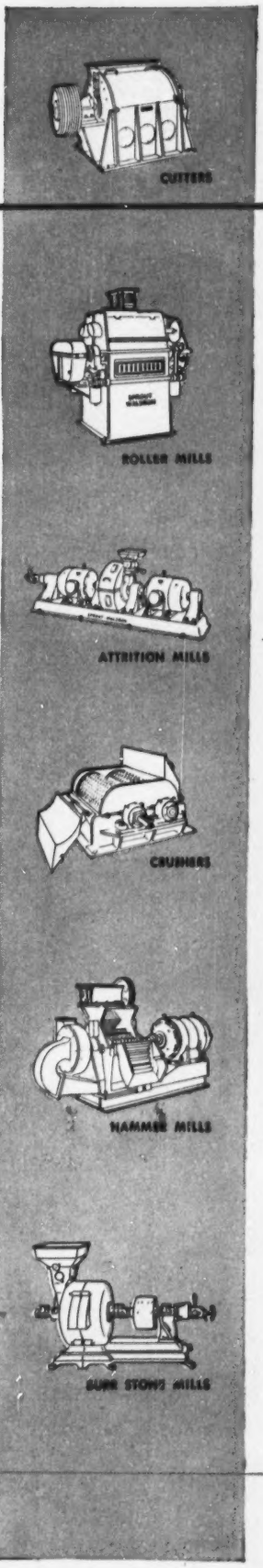
Pulling rags apart into threads or ragged swatches, flocking sheet pulp, pulping wood chips, shredding leather, defiberizing old rubber tires, shredding jute—to name only a few widely scattered operations that can be classified as involving a defiberizing action—are applications on which Sprout-Waldron engineers and Sprout-Waldron products can combine to give you the *one best* answer. Each case must be investigated as to material and end results desired. And from such an investigation will come a recommendation that very conceivably can put you far ahead of your competition.

...PULVERIZING?

For many operations classified as pulverizing, Sprout-Waldron can supply the *one best* answer from a vast line of size reduction equipment. And if Sprout-Waldron doesn't have your *one best* answer, you'll be told who does have it.

For some pulverizing, hammer mills are often the answer, and Sprout-Waldron has an interesting and unique line of units that have solved many different processing problems by proper selection of hammers and screens. Many times attrition mills or roller mills furnish the *one best* answer, and where a fine, floury texture is particularly important, burr stone mills can sometimes be the solution.

Each size reduction problem has a solution that is the one best answer and that can be determined by submitting the problem to Sprout-Waldron. You will receive a recommendation based on the combined experience of men working constantly with size reduction problems and backed by successful case history files of processing solutions, and laboratory processing test data. If Sprout-Waldron equipment does not meet your needs, you'll be directed to a manufacturer who can supply the one best answer. Let Sprout-Waldron study your size reduction problems without cost or obligation.



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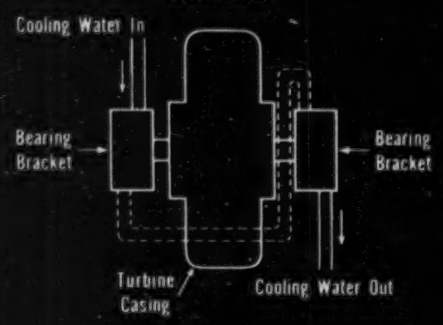
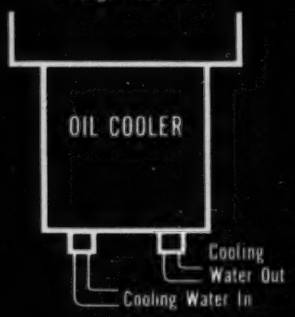


WITH G-E TYPE DP MECHANICAL-DRIVE TURBINE (All oil cooled in single reservoir)



Pipe cooling water into single oil cooler only—this feature of G.E.'s Type DP turbine saves time and extra piping costs in turbine installation.

ANOTHER PLUS VALUE OF G-E MECHANICAL-DRIVE TURBINES...

Single Oil Cooler Saves Extra Turbine Piping Costs

You save on installation costs with a G-E mechanical-drive turbine because General Electric pipes the bearing oil back to a single reservoir for cooling, in a single oil cooler. This eliminates the extra costs of running cooling water piping to and between each bearing. This feature alone can save you up to $50.00.

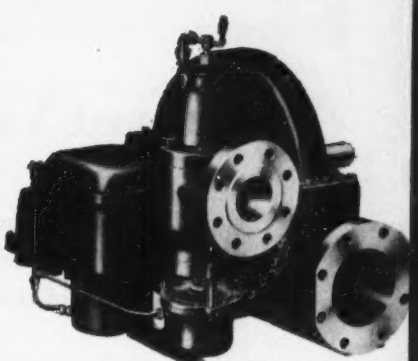
This single oil cooler is just one of the many features on the Type DP turbine which save you money. The chart below indicates other areas of savings.

Remember—the total cost is often more than just the sales price. But G.E.'s standard DP turbines include the extra features that save you extra costs. For more information contact your nearest G-E Apparatus Sales office. Write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." General Electric Company, Schenectady 5, N. Y. 252-64

GENERAL ELECTRIC

INSTALLATION AND MAINTENANCE COST-SAVING FEATURES

THESE EXTRA FEATURES, STANDARD ON ALL G-E TYPE DP TURBINES, CAN . . .	Save You up to
COMBINED TRIP-THROTTLE VALVE Eliminate extra cost of buying and installing valve ahead of the turbine.	$200.00
SINGLE RESERVOIR FOR COOLING LUBE OIL Eliminate extra cost of piping cooling water to and between bearings.	50.00
MAJORITY OF PARTS INTERCHANGEABLE One set of spare parts protects several units—less money tied up in inventory.	100.00
METALLIC-LABYRINTH VALVE STEM BUSHING Eliminate labor costs of replacing soft packings; cut down-time production losses.	50.00
SHAFT MONEL-SPRAYED AT PACKING FIT Saves frequent cost of purchasing and installing carbon rings; contributes to long shaft and packing life.	20.00
ESTIMATED TOTAL SAVINGS	$420.00



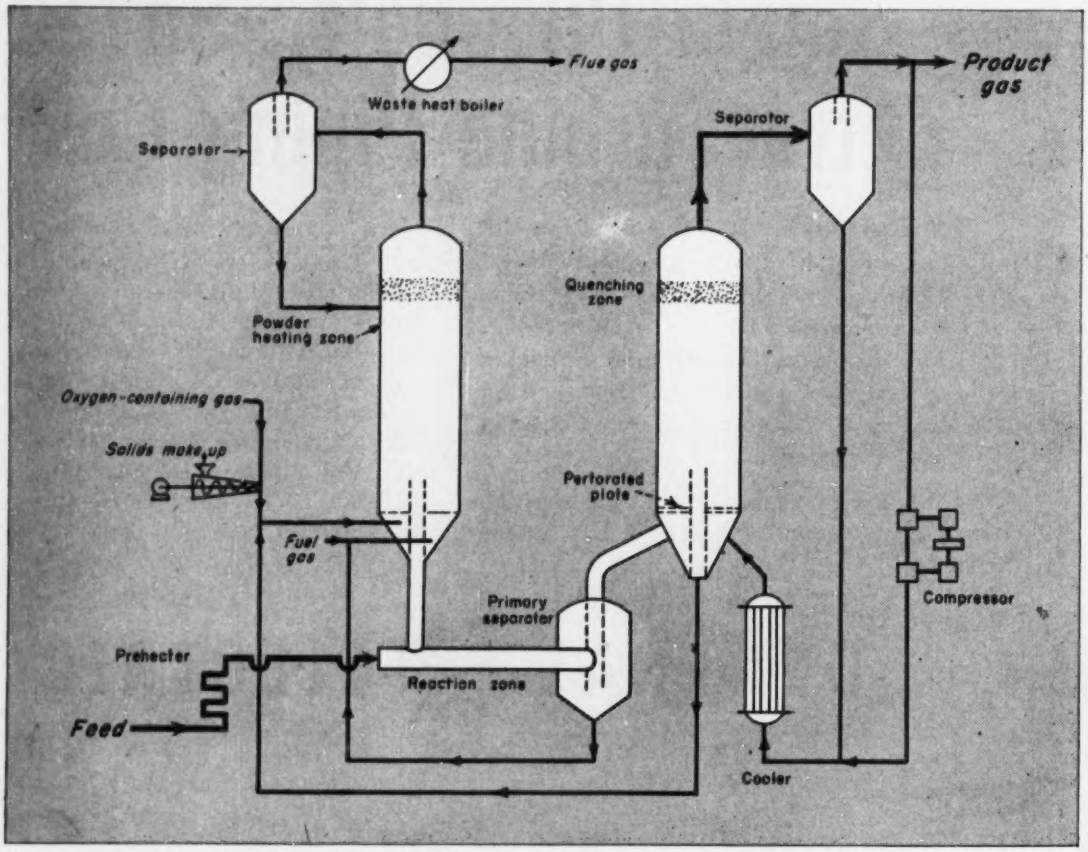
G-E Type DP Mechanical-drive Turbine

COMPARE THE FEATURES

EVALUATE ALL THE COSTS

See why G-E standard Type DP turbines are your most economical buy.

NEW EQUIPMENT PATENTS



Improved Vapor-Phase Reactor Design

High-temperature gaseous conversion in short contact time. These are the features of a novel design employing the fluidized-bred technique.

Many vapor-phase conversions may move out of the laboratory into the plant as a result of a newly designed apparatus which provides and maintains high temperatures throughout short periods of reaction.

▶ **Primary Units**—The novel M. W. Kellogg apparatus consists of three primary units:

- Fluidized-bed, powder-heating zone—in which fluidized solids are preheated and carbonaceous deposits (formed during conversion) are oxidized.
- Reaction zone—in which solids are suspended in and contacted with a gaseous stream for short periods.
- Fluidized-bed, quenching zone—in which conversion products are rapidly cooled.

▶ **Reaction Zone**—Hot fluidized solids (preheated in the powder-heating zone) flow into the reaction zone at a controlled rate. Preheated gas enters the reaction zone at a temperature such that undesirable side reactions will not occur. The resulting gaseous suspension sweeps through the zone at a high velocity—with very rapid heat exchange between gas and solids.

From the reaction zone, the suspension flows into a primary separator which removes part of the sus-

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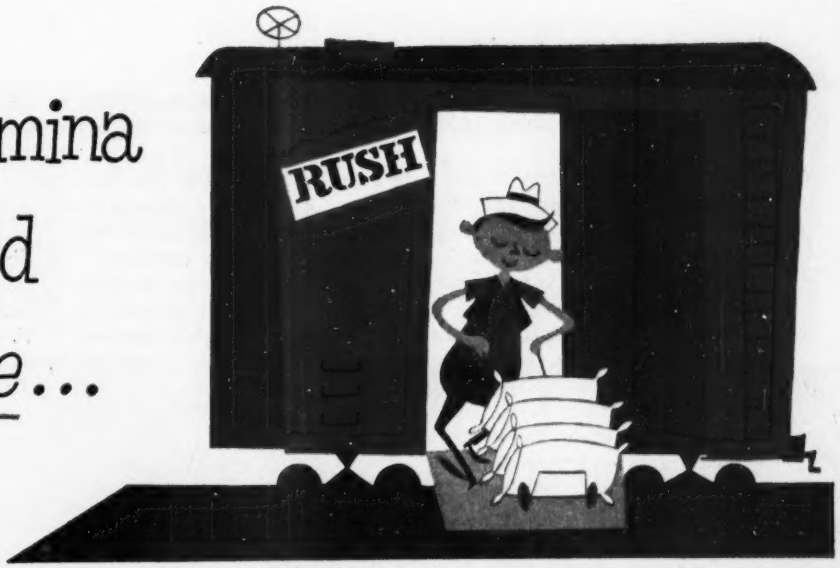

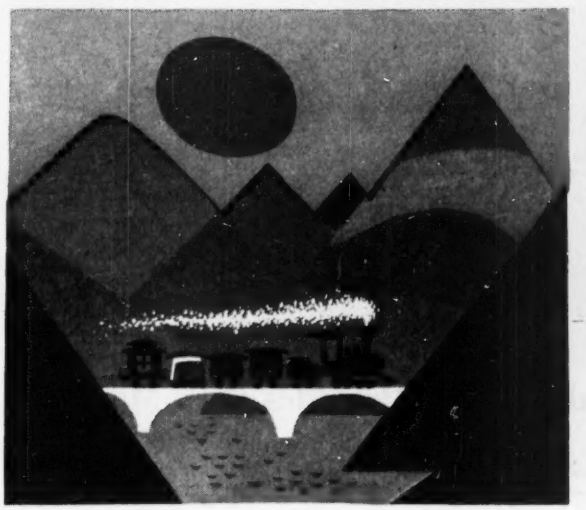

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pended solids. These are returned to the fluidized-bed, powder-heating zone.

▶ **Quenching Zone**—Gaseous conversion products and remaining solids flow into the quenching zone. Here products are cooled by removing the solids and recycling them through an external cooler.

Conversion products and residual suspended particles are taken overhead to a separator. The particles are recycled. Some of the product gas is removed while the rest—to be used as a suspending medium—is recycled through a compressor.—**U. S. 2,675,294 by P. C. Keith to The M. W. Kellogg Co.**

How You Can Hike Evaporator Efficiency

Steam added to an evaporating solution increases the heat transfer efficiency in multiple-effect evaporators. The principle is old, but the proposed mechanism for achieving it is new.

In a novel apparatus, a small auxiliary boiler (situated below the evaporator) injects steam into the solution to be evaporated, forming an emulsion. The emulsion then flows into the evaporator tubes.

Here the steam tends to form a central core which forces a thin film of liquid against the tube walls, producing a "climbing effect." It is this effect which is claimed to hike the efficiency of the evaporator.—**U. S. 2,676,651 by Jean Loumiet et Lavigne.**

New Twist in Infrared Drying

Unlike the conventional glass support for material dried by infrared radiation, a new support is transparent to radiation in the range of 1 to 10μ.

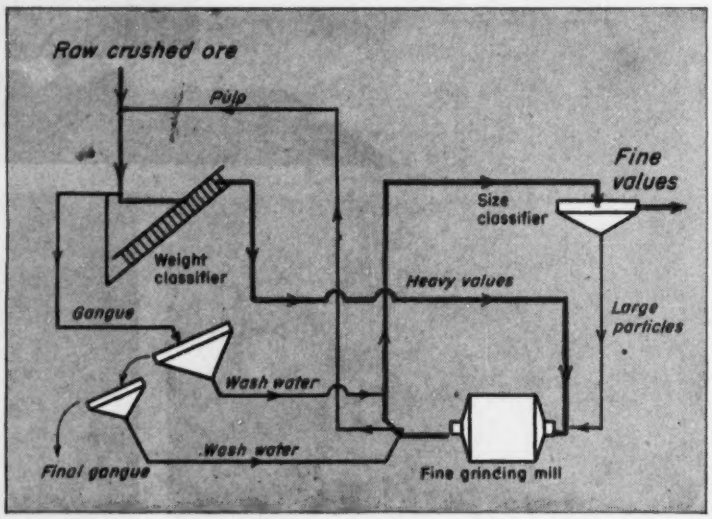
The new support consists of a woven spun-glass fibered fabric coated with a polyethylene-type plastic. Each drying temperature range has its own recommended coating.

Tetrafluoroethylene polymer is used at high temperatures (670 F.); polyethylene at low temperatures (100 F.); trifluoromonochlorethylene at intermediate temperatures.

▶ **Fabric Vs. Glass**—The high transparency of the coated fiber—as evidenced by a comparison of it with glass plate—is doubly important:

• The greater the transparency, the less energy absorbed by the support. Result: less chance of heating the support and ultimately melting and decomposing the material being dried.

• Energy most efficiently absorbed by water—in the wave band of 2.6 to 3.1μ—passes through the fiber support (but not through glass). Thus drying efficiency is increased.—**U. S. 2,668,364 by Ralph F. Colton to Dry-Freeze Corp.**



Float-Sink Method Provides Own Medium

Here's a switch on the "float-and-sink" method of classifying ores which involves an economy-saving step. Where conventional methods involve the addition of an artificial medium—a heavy liquid or suspension of solids in liquid—to facilitate gravity separation of ore particles, the new apparatus uses a portion of the feed to effect this separation.

Three variations of the new technique are cited in the patent. One of these—separating gangue from ore values—gives you a clear picture of the operation.

▶ **Weight Separation**—First step: a weight classifier separates raw crushed ore into two fractions—light gangue and heavy ore values. The gangue overflows into a screening system for further treatment. Heavy values, exiting from the classifier bottom, enter a closed-circuit grinding system consisting of a fine grinding mill and size classifier.

▶ **Grinding System**—Ore values, mixed with large particles exiting from the size classifier, are ground in the mill. Part of the mill effluent is recycled to the size classifier (hydroseparator). The rest is recycled to the weight classifier to provide a high enough bath density for separating ore constituents.

The gangue—along with much of the fines in the crushed ore and pulp from the grinding mill—undergoes two screenings and washings. All or part of the wash water from the first screen flows into the grinding system. Wash water from the second screen is the suspending medium for that portion of the mill effluent which is recycled to the weight classifier.—**U. S. 2,675,966 by Per Gudmar Kihlstedt to Bolidens Gruvaktiebolag.**

Meet the man you can call with confidence to solve your thermal insulation problems

To insulate outdoor tanks with complete weather protection, these skilled J-M applicators follow a specification developed by Johns-Manville. Here they are fastening J-M Asbestocite* Sheets over J-M Zerolite* Insulation. J-M 85% Magnesia Insulation is also widely used for this type of equipment

He is your J-M Insulation Contractor... the man with the world's most complete insulation engineering service

"Insulation is no better than the man who applies it." Today, with rising fuel and maintenance costs, it is especially important to place your insulation job in skilled hands. The scientific application of J-M quality insulations by J-M Insulation Contractors will assure you of the maximum return on your insulation investment for years to come. Moreover, you get undivided responsibility for *all* your insulation requirements.

1. You get dependable materials—Johns-Manville manufactures a complete line of insulations for every service temperature from minus 400F to plus 3000F. From them your J-M Insulation Contractor can select the right insulation for the most dependable service on your job. To develop new and improved insulation materials Johns-Manville maintains the J-M Research Center—largest laboratory of its kind in the world.

2. You get dependable engineering—For 95 years Johns-Manville has been accumulating insulation engineering experience. J-M Insulation Engineers are called upon to solve insulation problems of every type and magnitude, in every industry. Since your J-M Insulation Contractor works closely with J-M Insulation Engineers, he brings to *every* job a high degree of training, skill and experience.

3. You get dependable application—Johns-Manville has set up a nationwide organization of J-M Insulation Contractors to serve you. These Contractors maintain staffs of insulation engineers as well as skilled mechanics thoroughly trained in J-M's proved application methods. You can have absolute confidence in their ability to apply J-M insulations correctly for trouble-free performance.

For further information and the name of your J-M Insulation Contractor, write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ont.

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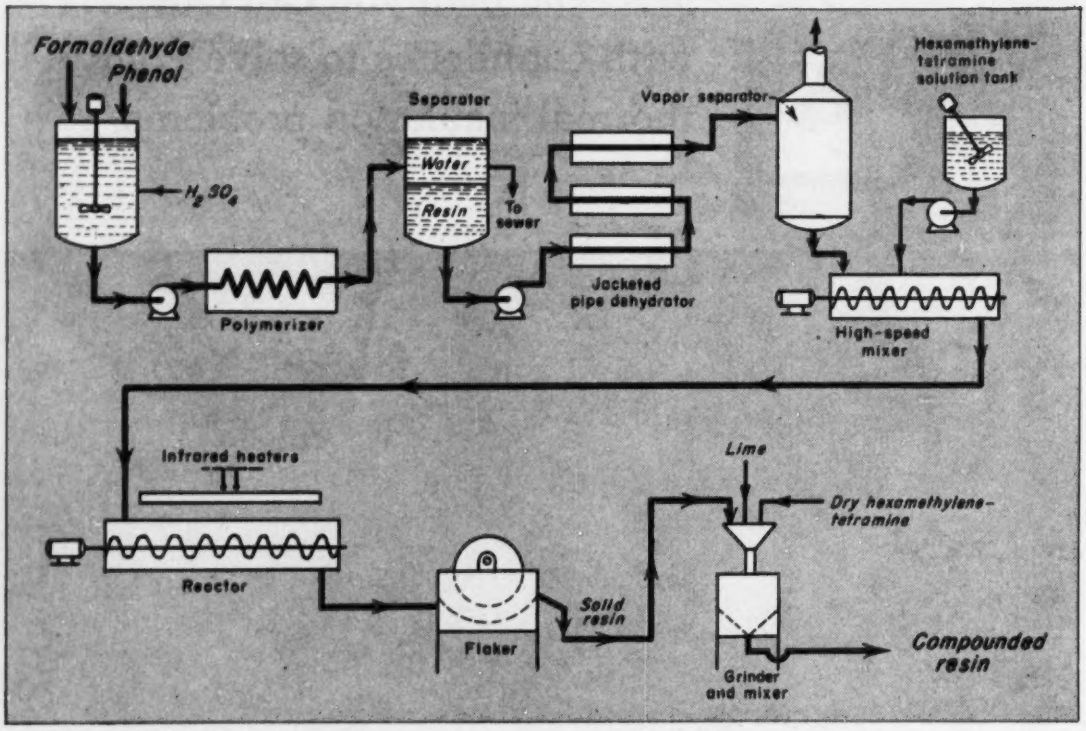
Johns-Manville *FIRST IN* INSULATION

MATERIALS • ENGINEERING • APPLICATION



New Technique Yields Heat-Reactive Binder

Phenol-formaldehyde resin undergoes special treatment to produce a low-flow, short-cure binder. Potential: manufacture of felted blankets.

Having problems with insulation blankets? Do they lack firmness and resiliency?

Allied Chemical and Dye offers you a way to master your difficulties in its new process for the production of a fiber binder which:

- Cures in 45 ± 15 sec. at 300 F.
- Flows 23 ± 5 mm. at 260 F.

▶ **Reactants Condensed**—First step in the new process is the intimate mixing of a 6:5 molal ratio of phenol and formalin with sulfuric acid catalyst (2 wt. %).

From the mix tank, the mixture goes to a steam-jacketed polymerization coil. Phenol-formaldehyde condensation is complete after a 20-30 min. heating period at 200-220 F.

Effluent from the polymerization coil flows into a separator tank, forming two layers—the upper, aqueous; the lower, resin. The upper layer discharges to a sewer. The lower layer flows through a steam-jacketed dehydrator coil in which it's rapidly heated to 300-340 F.

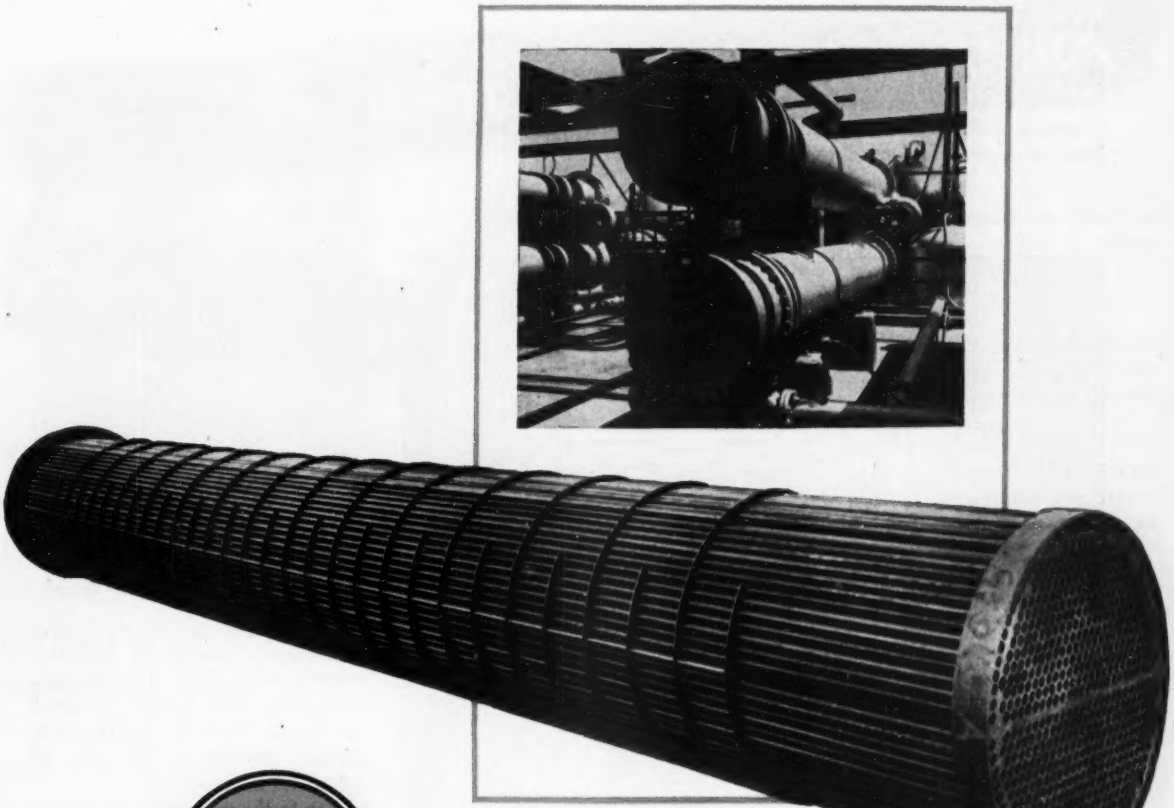
Next step: vapors and liquid from the coil enter a vapor separator. Water vapor, together with small amounts of unreacted phenol and formaldehyde, exits from the separator top. Molten dehydrated resin (Novolak)—melting at 195-212 F.—exits from the bottom. Production of resin is continuous.

▶ **Heat-Reactive Resin**—Addition of hexamethylenetetramine to the Novolak yields a final product having short-cure, low-flow and heat-reactive properties.

Molten resin and a 40% aqueous solution of the tetramine simultaneously enter a high-speed mixer. Tetramine is pumped at a controlled rate so that its final concentration in the resin mixture is 0.5 to 3 wt. %.

From the mixer, the mixture enters a reactor—a 12-ft. length of 12-in. helicoid screw housed in a steam-jacketed, U-shaped, open-topped trough. Heating for no more than 3 to 5 min. at 300-350 F. produces a uniform product. Infrared heaters above the reactor trough supply the necessary heat; the speed of the helicoid screw controls the reaction time.

The heat-reactive resin discharges —from the reactor—onto a flaker.



GULF uses ELECTRUNITE

Heat Exchanger Tubes

In fact, ELECTRUNITE Tubes have been in Gulf heat exchangers for the past twenty years, helping to keep refinery processes on-stream.

This kind of dependability begins with the steel used in Republic ELECTRUNITE Tubes. Made in Republic's own mills, its quality is controlled from ore to finished tubing.

Ductility is controlled for uniformity. Corrosion resistance is uniform all around the tube, from end to end. And full normalizing in controlled atmospheres assures clean, scale-free surfaces.

These advantages can add up to this:

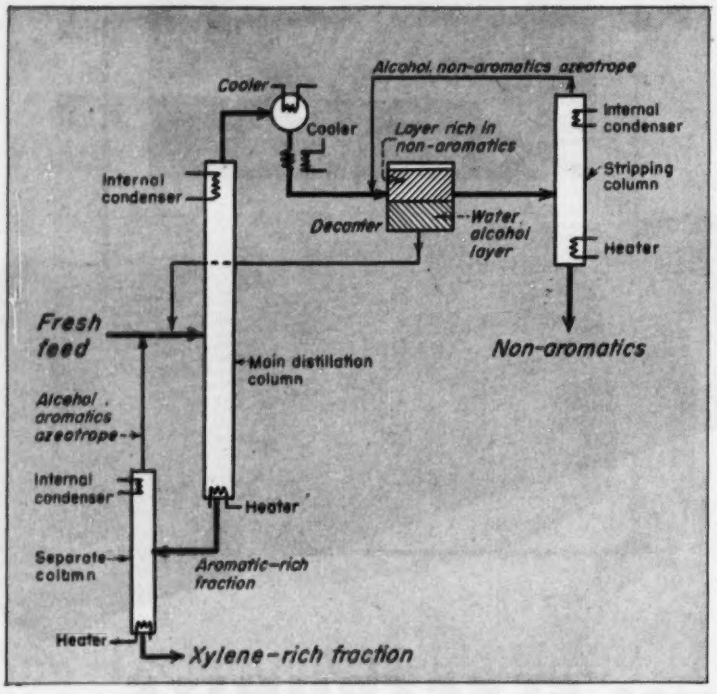
1. **Longer time between re-tubings**
2. **More hours of production with less down time**
3. **Lower cost per year**

These facts have been proved not only by Gulf, but by the millions of feet of ELECTRUNITE Heat Exchanger Tubes used in thousands of heat exchangers in scores of industries. You can find more facts in Booklet CEC-54. Write for it.

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
203 E. 131st Street, Cleveland 8, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N.Y.

Republic ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Here it cools and solidifies. Further blending with dry hexamethylenetetramine and (if desired) lime is done in conventional grinding and mixing devices.–U. S. 2,674,589 by Gordon A. Coleman and Leslie T. Sutherland to Allied Chemical & Dye Corp.



Separating Xylenes From Non-Aromatics

To the list of scavengers used to separate xylenes and non-aromatics by azeotropic distillation, add one more–2-methoxy-ethanol (Methyl Cellosolve) containing a small amount of water.

In a new process, enough water (about 3.5%) is added to 2-methoxy-ethanol to:

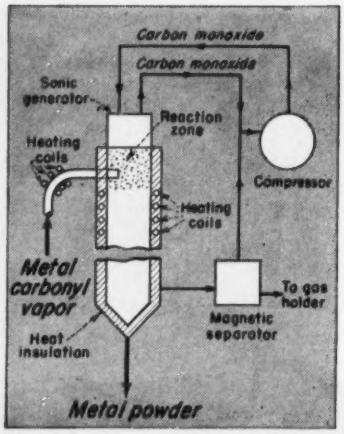
- Prevent phase separation in the distillation column.
- Prevent formation of a ternary azeotrope of water, solvent and non-aromatics in the overhead product.
- Cause phase separation of overhead product–when cooled to 80 F.

▶ **Non-Aromatics Separated** – The lower layer of overhead from the distillation column contains solvent, water and some non-aromatics. This layer is recycled to the feed point.

The upper layer, rich in non-aromatics (and containing some solvent), enters a stripping column. Overhead from this column is an azeotropic mixture of solvent and non-aromatics which is recycled to the decanter. Non-aromatics are withdrawn as bottoms.

▶ **Xylenes Recovered**–For good separation of aromatics and non-aromatics, you should leave a small amount of solvent in the bottoms from the distillation column. This solvent is removed in an azeotrope with xylene from the top of a third or separate column.

The azeotrope is returned to the feed point. Pure xylenes are recovered as bottoms from the separate column.–U. S. 2,672,436 by Gordon H. Foxon to Imperial Chemicals Industries Ltd.



Fine Metallic Powders For High Frequency Work

The appetite of high and ultra-high frequency devices for fine magnetic materials is on the increase. To satiate their hunger, a novel process has been devised to yield metallic particles in the range of 0.1 to 1.5 microns.

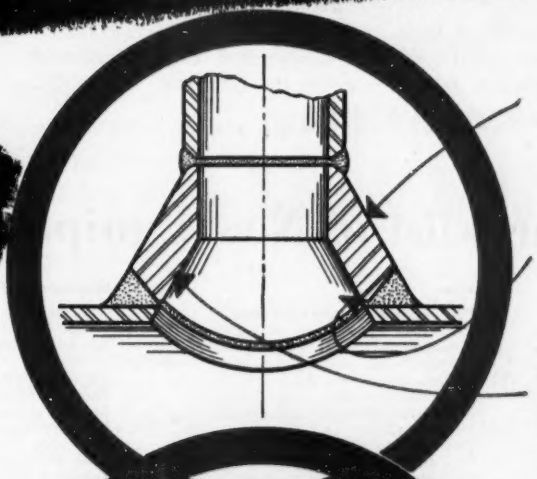
Key to the new method–a modification of the Mond process–is the application of a sonic or ultrasonic field across a metal carbonyl decomposition reactor.

▶ **The Old**–In conventional metal carbonyl decomposition, the first step–much like that resulting from the slow rate of crystallization of a solution–is the formation of several large nuclei. Once these form, the vapor preferentially decomposes on them (rather than form new nuclei). Result: a mixture having a large percentage of over-sized particles.

▶ **The New**–The new technique follows the old–up to a point. Metal carbonyl vapor feeds into a steel reactor at the rate of 5 cu. ft. per min. Heating coils–in the reactor wall–supply the temperature

This department is designed to keep you abreast of the latest developments in chemical equipment and processes. Any patents may be ordered from the Commissioner of Patents, Washington 25, D. C. The cost: 25 cents per patent.

Engineered Reinforcement Against CORROSIVE ATTACK at Branch Connections



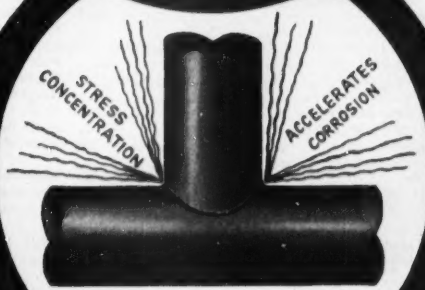
Designed with thick, tapered section to relieve stress concentration.

Additional metal prevents branch connection from corroding dangerously thin.

Funneled inlet relieves stress concentration at point of highest magnitude—the *inside* of the crotch.

Accelerated corrosion due to stress concentrations can be readily eliminated . . . by using WELDOLET WELDING FITTINGS at all 90° branch connections.

When corrosion exists in a piping system, it attacks the points of stress concentration most severely. WHY DOWN-RATE YOUR PIPING SYSTEM BECAUSE OF THIS WEAK LINK?



SPECIFY AND USE . . . . . BONNEY WELDOLET WELDING FITTINGS to insure 100% pipe strength at branch connections under corrosive conditions.

WeldOlets, butt-welding

ThredOlets

WeldOlets, socket-welding

FOR COMPLETE ENGINEERING DATA WRITE FOR YOUR BONNEY W-3 CATALOG

DISTRIBUTORS IN PRINCIPAL CITIES

WELDING FITTINGS DIVISION

BONNEY FORGE & TOOL WORKS

ENG. DEPT. 732 MEADOW STREET

ALLENTOWN, PENNSYLVANIA

necessary for vapor decomposition. The optimum temperature range is 470-490 F.

But here's the switch. A sonic or ultrasonic generator (siren type) atop the reactor artificially induces the formation of a large number of particle nuclei per unit quantity of carbonyl. Result: a mixture of small particles.

Compressed carbon monoxide drives the generator. Excess CO, exiting from the reactor bottom, enters a magnetic separator where entrained metal is removed.—**U. S. 2,674,528 by Hans Beller and Otto W. Schnetzler to General Aniline & Film Corp.**

Your Checklist of New Equipment Patents

Operation . . .	About . . .	Inventor or Assignee . . .	Patent No . . .
Adsorption	Purification of gases by adsorption	Gesellschaft fur Linde's Eismaschinen A. G.	2,675,089
Chemical reaction	Controlling temperatures of highly exothermic reactions	Standard Oil Development Co.	2,674,612
	Continuous high temperature endothermic reaction between a solid and gas	Joseph Daniels	2,675,295
	Pebble heater reactor	Phillips Petroleum Co.	2,675,999
	Hydrocarbon coker	Institute of Gas Technology	2,676,913
Crushing and grinding	Attrition mill	Nordberg Mfg. Co.	2,670,142
	Fluid impact pulveriser	Blaw-Knox Co.	2,672,296
	Discharging powdered material from rotary mills	Acheson Colloids Ltd.	2,675,967
	Impacter for solids disintegration	Lukens Steel Co.	2,675,969
Dialysis	Dialysis column	H. A. Saroff and G. H. L. Dillard	2,675,349
Drying	Dryer for porous materials	U. S. Rubber Co.	2,674,811
	Spray dryer	Western Condensing Co.	2,675,070
	Selective drying of webs	Raytheon Mfg. Co.	2,676,416
Extraction	Liquid-liquid extraction with viscous solvents	Phillips Petroleum Co.	2,674,563
Extrusion and molding	Parallel mold blower for plastics	Plax Corp.	2,674,006
	Extruder for production of insulating covering	Schweizerische Isola-Werke	2,674,007
	Automatic molder	Grayhill	2,675,583
	Plastic mold feeder	A. C. I. Plastics Prop. Ltd.	2,675,584
	Screw press for extruding plastics	Carlo Pasquetti	2,676,355
	Plastic molding conversion attachment for reciprocating presses	James F. Shannon	2,676,357
Filtration	Apparatus for reverse flow cleaning of air filters	Lorenzo Antonelli	2,674,342
	Continuous filter	The Sherwin-Williams Co.	2,675,129
	Filter press and handle	American Cyanamid Co.	2,675,921
	Traveling tray-belt filter	The Dorr Co.	2,677,467
Fluid and particle flow	Sparging apparatus	Phillips Petroleum Co.	2,673,078
	Elevating conduit for contact material	Sun Oil Co.	2,673,764 & 2,673,832
	Jet pumping system	The Dayton Pump & Mfg. Co.	2,674,189
	Pumping apparatus for abrasive slurry	General Electric Co.	2,674,190
	Elevator for contact material	Sun Oil Co.	2,674,496-9
	Apparatus for elevating granular material	Houdry Process Corp.	2,675,275
Gas absorption	Absorbing hydrocarbons from gases	The Lummus Co.	2,675,095
	Benzol spray scrubber	Carl Otto	2,675,215
	Gas contactor	Laurance S. Reid	2,677,435
Heat transfer	Sinuous wire elements as extended surface on heat exchanger plate wall	The Air Preheater Corp.	2,670,936
	Decoking and cleaning tubular heaters	The Texas Co.	2,671,741
	Circular updraft heater	Universal Oil Products Co.	2,672,130
	Tube and plate heat exchanger	Louis Weiss	2,672,324
	Mechanical draft cooling towers	The Marley Co.	2,672,328
	Cleaner for heat exchange tubes	Elliott Co.	2,672,636
	Convection fluid heat exchange system	The Babcock & Wilcox Co.	2,672,850
	Pebble heater	Phillips Petroleum Co.	2,673,791
	Combination warm air furnace and multiple tube heat exchanger	Francis T. Ethredge	2,674,240
	Envelope-type radial seal for regenerative heat exchangers	The Air Preheater Corp.	2,674,442
	Plate heat exchanger	Nils R. G. Ekwall	2,676,000
	Plate heat exchanger	Rudy Mfg. Co.	2,676,001
	Device for recording deformation of operating rotary furnaces	Skanska Cementaktiebolaget	2,676,867
Instrumentation and control	Catalyst flow indicator or control	Instruments, Inc.	2,674,363
	Proportioning liquid flow with stream divider	The Pure Oil Co.	2,676,602
	Fluid flow divider	Paul Kollsman	2,676,603
Liquid-liquid separation	Oil-water separation	Elmer R. Williams	2,675,126
Mixing	Liquid mixture control apparatus	Triangle Package Machinery Co.	2,674,256
	Agitator for mixers	Clearfield Machine Co.	2,677,533
	Blender	The Patterson-Kelley Co., Inc.	2,677,534
Screening	Corrugated slot screen	Georgia Tech Research Institute	2,674,374
Solid-gas contacting	Contacting gases and granular solids	Food Machinery & Chemical Corp.	2,676,668
Solid-gas separation	Voltage control in precipitators	The Air Preheater Corp.	2,672,947
	Ionizing unit for electrostatic filters	Trion, Inc.	2,672,948
	Smoke filter	James P. Montgomery	2,673,620
	Apparatus for cleaning hot gases	Trion, Inc.	2,675,090
	Support for charging electrodes for electrostatic filters	Air-Maze Corp.	2,675,091
	System for energizing electrical precipitators	Research Corp.	2,675,092
	Dust collector having low draft loss	Detroit Stoker Co.	2,677,437
	Collection of suspended particles	Research Corp.	2,677,439
Solid-liquid separation	Centrifuge	Machinenfabrik Reineveld N. V.	2,676,707
Solid-solid separation	Sand classifying and dewatering device	The Conveyor Co., Inc.	2,675,128

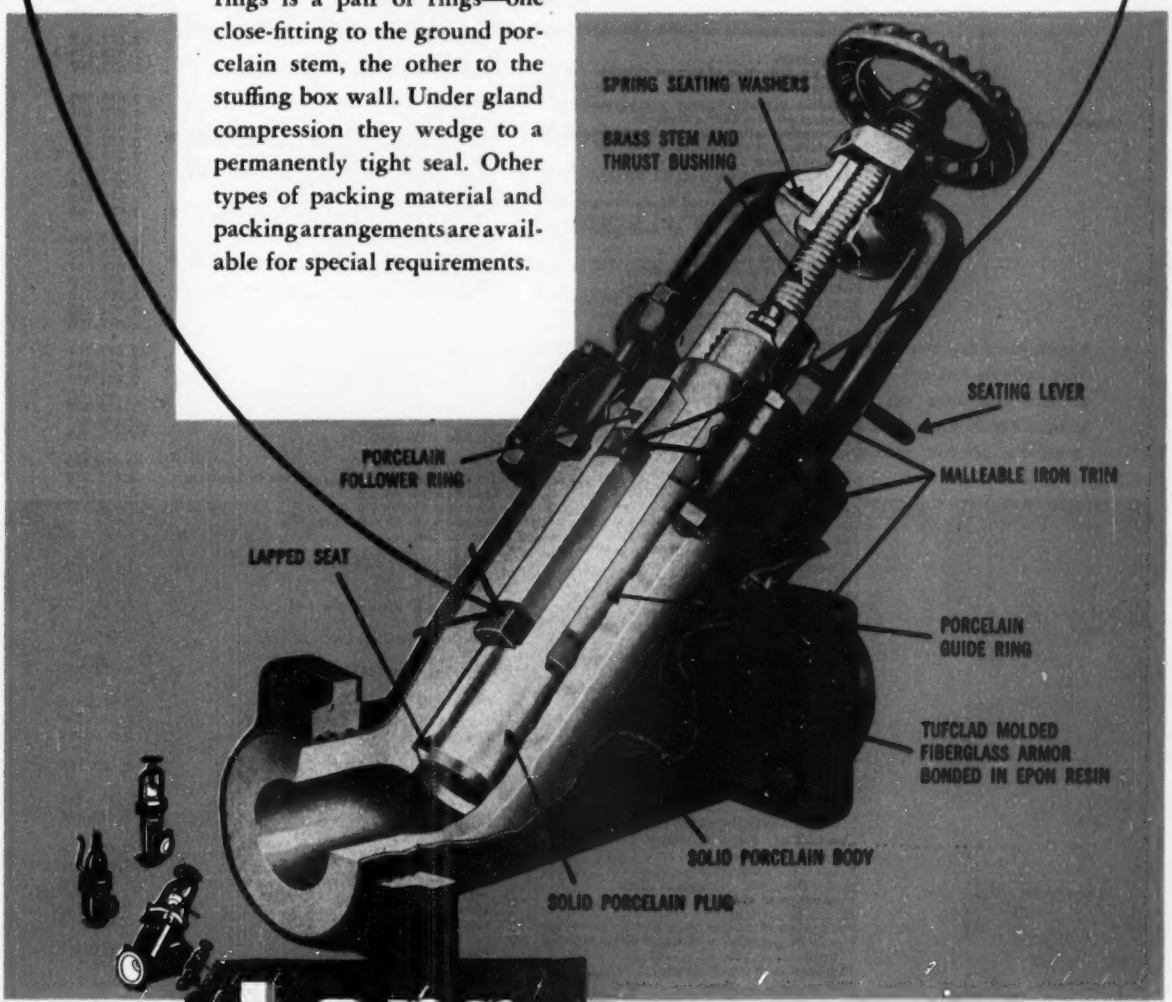
Teflon Packing

..."all-service"

...maintenance-free

in Lapp Valves

Solid, unfilled Teflon, in a wedge-ring arrangement, provides a packing for Lapp Porcelain valves which is long in serviceability, short on maintenance requirements. Each of the two sets of Teflon wedge-rings is a pair of rings—one close-fitting to the ground porcelain stem, the other to the stuffing box wall. Under gland compression they wedge to a permanently tight seal. Other types of packing material and packing arrangements are available for special requirements.



Lapp

PROCESS EQUIPMENT

Chemical Porcelain Valves • Pipe • Raschig Rings
Pulsafeeder Chemical Proportioning Pumps

Y-valves, angle valves, flush valves, safety valves, and plug cocks of Lapp Porcelain have standard bolt-circle flanges for easy connection to all piping and equipment. Write for bulletin with complete description, characteristics, and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 305 Wendell St., LeRoy, N. Y.

. . . And New Process Patents

Product . . .	Process . . .	Inventor or Assignee . . .	Patent No . .
Carbon	Pelletizing carbon black	J. M. Huber Corp.	2,674,522
	Lowering pH of furnace blacks	Phillips Petroleum Co.	2,676,873
Catalysts	Catalyst preparation for vapor phase oxidation of benzene to maleic anhydride	Monsanto Chemical Co.	2,674,582
Fuels	Gasification of carbonaceous solids	Hydrocarbon Research, Inc.	2,674,525
	Purification of fuel gases	Heat and Industry, Inc.	2,676,670
	Motor fuels from carbonized liquids	Standard Oil Development Co.	2,676,908
Gases	Destruction of air contaminants by combustion	Frank Schneider	2,674,339
	Preparation of chlorine dioxide	Deutsche Gold-und-Silber-Scheidenanstalt vormals Roessler	2,676,089
Inorganic chemicals	Electrolysis of sodium sulfate	American Viscose Corp.	2,669,542
	Sodium carbonate monohydrate manufacture	Columbia-Southern Chemical Corp.	2,670,269
	Production of pure dihalides of titanium or zirconium	James F. Jordan	2,670,270
	Production of ortho-phosphoric acid	Monsanto Chemical Co.	2,670,274
	Nonchalking titanium dioxide production	American Cyanamid Co.	2,671,031
	Separation and use of ammonium chloride in ammonia-soda process for sodium bicarbonate production	Mathieson Chemical Corp.	2,671,713
	Electrolytic production of fluoborates	The Pennsylvania Salt Mfg. Co.	2,673,837
Metals and ores	Conversion of metals into their oxides and hydroxides	John E. Munn & Co.	2,670,273
	Separation of nickel from cobalt-nickel solutions	Marcel De Merre	2,671,712
	Zinc production	The National Smelting Co. Ltd.	2,671,725
	Continuous roasting of lead-containing sulfide ore	The Broken Hill Associated Smelters Proprietary Ltd.	2,672,412
	Zinc recovery	D. W. Duncan and P. Eustis	2,673,178–9
	Hydrogen reduction of ferrous chloride vapor	Republic Steel Corp.	2,673,797
	Recovery of cadmium from cadmium-containing residues	Duisberger Kupferhuette	2,676,096
Organic chemicals	Manufacture of maleic anhydride	George Barsky	2,670,355
	Regenerating carboxylic acids from their salts	Stanolind Oil and Gas Co.	2,670,366
	Manufacture of unsaturated aldehydes	The Distillers Co. Ltd.	2,670,379
	Olefin oxidation	The Distillers Co. Ltd.	2,670,380–1
	Alcohols from olefins	The Texas Co.	2,670,385
	Production of alcohols	Allied Chemical & Dye Corp.	2,670,386
	Production of unsaturated fluorochlorocarbon	Allied Chemical & Dye Corp.	2,670,388
	Halocarbons manufacture	The M. W. Kellogg Co.	2,670,389
	Catalyzed condensation of aromatics with unsaturated cpds.	Universal Oil Products Co.	2,670,390
	Methyl acetate distillation	Celanese Corp. of America	2,671,052
	Purification of phthalic anhydride	Monsanto Chemical Co.	2,671,054
	Purification of phthalic anhydride	Standard Oil Co. (Ind.)	2,671,090
	Separation of isomeric mixtures of nitroanilines	Dr. Salsbury's Laboratories	2,671,110
	Noncatalytic isomerization of aromatic cpds.	Universal Oil Products Co.	2,671,120
	Acylation of aminosulfonic acids	American Cyanamid Co.	2,671,790
	Neutralization of sulfonic acids and sulfonic acid esters	Ruhrchemie A. G.	2,671,797
	Alcohol synthesis process	Standard Oil Development Co.	2,671,814
	Manufacture of diarylalkanes	Universal Oil Products Co.	2,671,815
	Electrical discharge purifies alcohols from olefinic cpds.	Shell Development Co.	2,672,440
	Decomposition of urea and thiourea adducts	Phillips Petroleum Co.	2,672,457
	Partial oxidation of methane	Phillips Petroleum Co.	2,672,488
	Unsaturated cpds. from pyrolysis of gaseous hydrocarbons	The Gyro Process Co.	2,672,489
	Production of aromatic polycarboxylic acids	De Directie van de Staatsmijnen in Limburg	2,673,216
	Selective oxidation of substituted aromatics	Eastman Kodak Co.	2,673,217
	Ethyl alcohol from hydrated ethylene	Eastman Kodak Co.	2,673,221
	Selective acetalization separates isomeric alcohols	Standard Oil Development Co.	2,673,222
	Aromatic hydrocarbons alkylated by isoparaffins	Sun Oil Co.	2,673,224
	Dechlorination of hydrocarbons containing organic chlorine	Phillips Petroleum Co.	2,673,226
	Dehydration of coal tar	Arthur H. Radasch	2,673,833
	Production of fluoro-olefins	Charles L. Thomas	2,673,193
Refractories	Manufacture of refractories	The General Electric Co. Ltd	2,675,323–4
Resins	Making water-soluble sulfonated vinyl aromatic resins	The Dow Chemical Co.	2,669,557
	Production and treatment of vinyl chloride polymer	Shell Development Co.	2,674,593
	Thermosetting laminate from condensation of formaldehyde with phenol and butyl phenols	Union Carbide & Carbon Corp.	2,675,335
	Production of a phenolic resin	Monsanto Chemical Co.	2,675,336
	Polymerization of styrene	Monsanto Chemical Co.	2,675,362
	Foamed products from aldehyde-modified alkyds and isocyanantes	United Aircraft Corp.	2,676,157
	Activated silicate clay used in styrene-alkyd reaction	Frank Armitage	2,676,159
	Modifying methyl methacrylate	George Kirkegaard, et al.	2,676,954
Rubber	Coagulating polymer latices prepared in true aqueous emulsion	Shell Development Co.	2,673,193
	Latex foam production	U. S. Rubber Co.	2,673,723
Synthesis gas and products	Motor fuel from synthesis product	The Texas Co.	2,671,104
	Production of synthesis gas	Standard Oil Development Co.	2,671,719–23
	Hydrocarbon synthesis	Hydrocarbon Research, Inc.	2,671,796
	Production of carbon black and synthesis gas	Godfrey L. Cabot, Inc.	2,672,402
	Catalytic conversion of oxygenated organic mixtures	Stanolind Oil and Gas Co.	2,672,476
	Preparation of synthesis gas	Hydrocarbon Research, Inc	2,674,524
	Hydrocarbon synthesis	Standard Oil Development Co.	2,674,611
	Recovery of organic oxygenated cpds.	Jefferson Chemical Co., Inc.	2,675,401
	Preparation of synthesis gas	Standard Oil Development Co.	2,676,156
Synthetic fibers	Cellulose production	British Celanese Ltd.	2,668,761
	Solutions of acrylonitrile polymers in mixtures of aqueous nitric acid and nitromethane	Paul Halbig	2,671,768
	Delustered superpolyamide articles	Societe "Rhodiaceta"	2,671,770
	Acrylonitrile purified by distillation	Monsanto Chemical Co.	2,672,434–5
	Removing carbon disulfide from viscose fiber with liquid seal vacuum pump	E. I. du Pont de Nemours & Co.	2,673,785
Water	Silica removal from water	Cochrane Corp.	2,668,144
	Deaeration of water	The Permutit Co.	3,671,524
	Treating water with calcium chloride fluoride	The Dow Chemical Co.	2,671,755
Waxes	Wax-oil separation	California Research Corp.	2,670,318
	Slabbing microcrystalline wax	Socony-Vacuum Oil Co., Inc.	2,677,152

WILFLEY PUMPS

A Vital Factor in Production Continuity

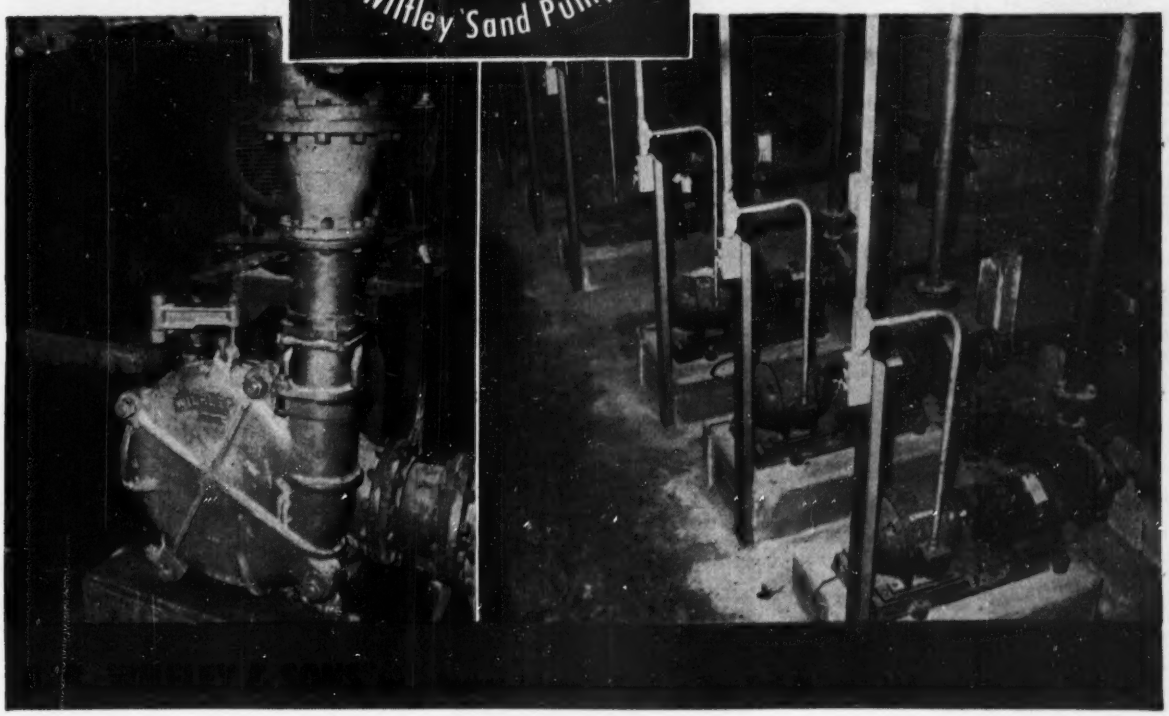
WILFLEY'S remarkable success-record in solving a great variety of pumping problems is well known to operators of mills and chemical plants all over the world. It is a record born of engineering "know-how" plus many years of experience in keeping pace with the changing requirements of modern industry.

- *Individual engineering on every application*
- *Cost-saving efficiency*
- *Reduced power and maintenance costs*
- *Continuous operation without attention*
- *Minimum replacement of parts*
- *Designed for simple installation*
- *Economical pump size for every requirement*

Write or wire for complete details.

Wilfley Acid Pump
"COMPANIONS IN ECONOMICAL OPERATION"
Wilfley Sand Pump

Typical Wilfley installations are shown below. Rubber lining and stainless steel are some of the materials used in Wilfley Sand Pumps and Acid Pumps to provide maximum pumping efficiency.



Choose ALLIS-CHALMERS Materials-Handling Equipment for Pit and Plant

For Excavating, HEAVY Lifting, Carrying Bulk or Solid Materials

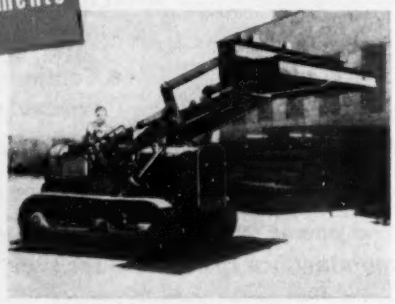
Use an Allis-Chalmers Tractor Shovel — with your choice of 12 Quick-Change Attachments

These tractor shovels handle big quantities of materials — loose, solid, packaged or unpackaged. Have the power, weight and traction to work anywhere, without bogging down. Four models, with lifting capacities of from two to six tons. Versatile — maintain yards and roads, clear away snow, spot cars, handle coal, keep busy the year around.

Handles Sand, Clay, Any Bulk

With standard 1-yd bucket, the HD-5G loads trucks, feeds hoppers and conveyors, builds stockpiles. Crawler tracks stand up in cullet and other abrasive material as only steel can.

Big 2-yd Light Materials Bucket for the HD-5G quickly cleans up and loads snow from yard roads and parking lots. Also doubles output in coal, coke, cinders and other light materials.



Skids, Loads, Stacks Solids — HD-5G Lift Fork attachment handles steel beams, pipe, lumber, packaged or palletized loads up to 4,000 lb. Works easily in unpaved yards where rubber-tired equipment bogs down.

Lifts and Carries with Crane — Crane Hook for HD-5G has capacity of 5,000 lb, lifting height of 11 ft, 6 in.

Other attachments include straight and angledozer blades, tine fork, trench hoe, rock fork, drag bucket, etc. (Not all attachments available for the three larger tractor shovels.) Attachments may be interchanged in about 20 minutes by simply removing and replacing four pins.

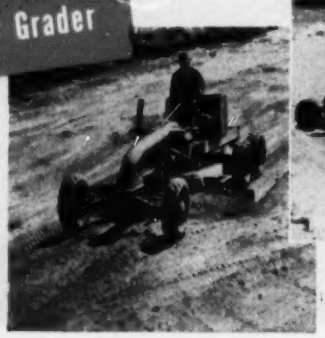
A SIZE TO FIT YOUR NEEDS

Tractor	Drawbar Horsepower	Weight	Bucket Size	Dumping Height*
HD-5G	40	16,200 lb	1 — 2 yd	9 ft, ½ in.
HD-9G	72	29,800 lb	2 — 3¼ yd	11 ft, 4 in.
HD-15G**	109	47,580 lb	3 — 5½ yd	11 ft, 7 in.
HD-20G	175***	63,325 lb	4 — 7 yd	12 ft, 10 in.

*Height of Bucket Hinge
**Also available with Torque Converter Drive — 135 Net Engine Hp
***Net Engine Hp — Torque Converter Drive

For Maintenance, Grading, Loading

Use the Low-Cost Model D Grader



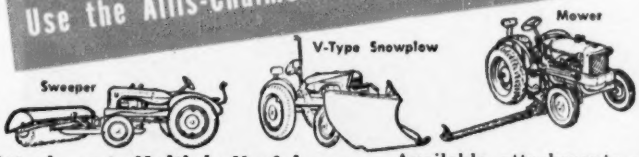
Builds and Maintains Roads, Parking Lots, Plant Areas — handles all types of grading, backfills ditches and trenches, levels, spreads rock, scarifies. Has many big-grader design and performance advantages — at a fraction of the cost. Tandem drive and 8,800 lb weight provide plenty of traction. Allis-Chalmers gasoline engine, 50 brake hp. For heavier work, diesel-powered graders available, 78 to 104 drawbar hp.

Loads Dirt, Snow, Other Bulk Materials with available ⅝-yd hydraulic bucket. Dumping height of 8 ft, 8½ in. allows easy loading of high truck bodies. Loads snow with bucket or cleans it with blade or V-type plow to keep winter operations on schedule.

For Hauling, Sweeping, Pushing and Pulling

Use the Allis-Chalmers IB Wheel Tractor

Speeds Handling and Maintenance Jobs
Here is a tractor built low, fast and powerful. Highly maneuverable — only 8 ft long, 4½ ft wide, turns in 7-ft radius. Has 14-in. ground clearance, unusual stability. Travels over railroad tracks, rough planking, up steep ramps. Speeds up to 8.5 mph. Develops 18 drawbar hp. Equipped with electric lights and starter.

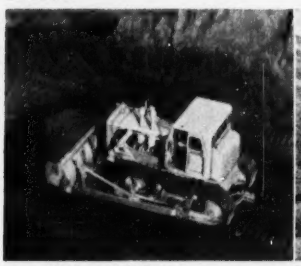


Attachments Multiply Usefulness — Available attachments include V-type and tripping blade snowplows, easily attached 72-in. sweeper, hydraulic sickle bar mower, winch, rear power take-off and belt pulley.

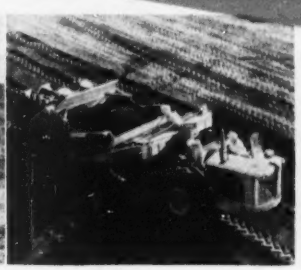
For Coal Handling, Earth Moving, Other Jobs

Choose from the Wide Line of Allis-Chalmers Equipment

Four Sizes of Crawlers — heavy-duty, diesel-powered, 40 drawbar hp to 175 net engine hp, 10,500 to 41,000 lb. These basic machines can be used for heavy drawbar work such as pulling scrapers, and logging arches or carts — or with wide choice of mounted attachments such as dozer blades, winches and cable control units, cranes and side booms.

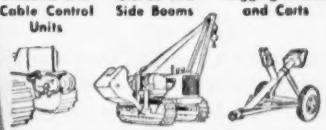

Dozer Blades of all Types

Seven Sizes of Scrapers, 2 to 23 yd



Motor Scrapers and Motor Wagons provide a means of moving large quantities of material fast and economically. TS-300 Motor Scraper shown here carries 18 cu yd of material (13½ tons of coal) at speeds up to 22.5 mph. Also available: TS-200 Motor Scraper with 13-yd capacity, and two Motor Wagons with capacities of 19 and 15 yd.

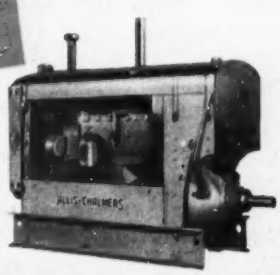
Winches and Cable Control Units | Cranes and Side Booms | Logging Arches and Carts



For Powering Conveyors, Hoists Elevators, Equipment of all kinds

Use Heavy-Duty, High-Torque Allis-Chalmers Engines

Stand Up in Grueling Service because they were designed for tractor use. Economically drive pumps, crushers, generators — any stationary or mobile equipment. Production-line built, their first cost is low — so are operating cost and upkeep. Nationwide service facilities. Choice of fuels. Three sizes can be used singly or together to fit any need.



Open or closed models — with accessories to fit the application		
Model*	RPM	Max. Bhp
B-125	1500-1800	24.5—28.4
W-226	1400-1800	48.3—56.4
E-563	1050	74.0

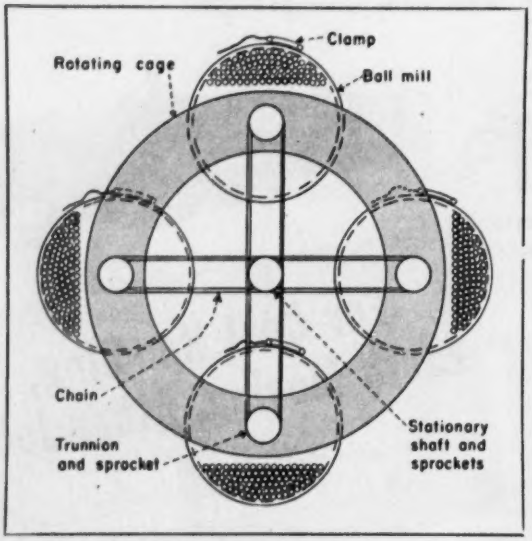
*Figures represent cu in displacement.

Send for Literature giving further information on any of this equipment in which you are interested — or see a nearby Allis-Chalmers Industrial Tractor Dealer in the well-established, nationwide dealer organization.

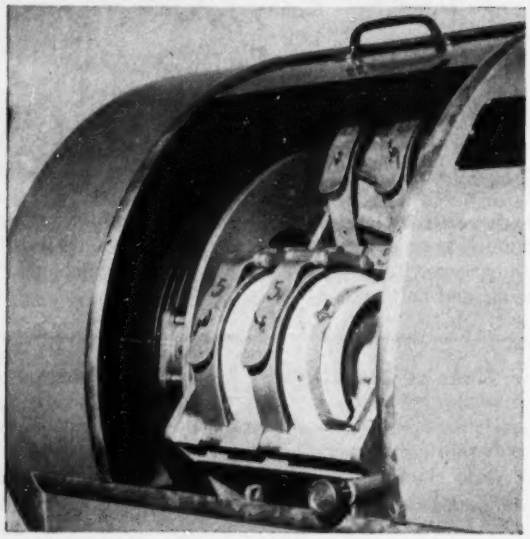
ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

NEW PROCESSING EQUIPMENT



BALLS MOVE inside swinging, non-rotating container.



CRADLE HOLDS one of mills, has quick-release clamp.

New Ball Mill Grinds Faster

Operating like a ferris wheel in reverse, this ball mill reduces particles to fine sizes in a fraction of previous time. Centrifugal force plays a key part.

The basic tool is the same. It's a cylindrical container filled with spherical grinding bodies. But the way it is handled is different, uniquely different. And therein, lies the reason for the superior performance of the Hyswing ball mill.

▶ **Swing It**—To understand how the Hyswing mill operates, picture yourself holding a small mill jar horizontally in front of you with the base against your abdomen. Now, if you were to swing the jar in a vertical circle you would duplicate the action of the Hyswing mill.

While the mill does swing in a circular path it is prevented from rotating about its axis by the grip of your hands. Meantime, inside the mill the contents are subjected to centrifugal force.

Under this influence they are held at all times at maximum distance from the pivot point of the swing. Net result: with each full swing of the jar the grinding bodies complete a turn inside the jar.

▶ **Four Mills in One**—This action is shown above in the sketch of the Hyswing mill. Four ball mills are mounted 90 deg. apart on trunnions attached to a cylindrical frame. Each mill has a sprocket connected by means of a chain to a separate sprocket on the stationary central shaft of the frame.

As the cylindrical frame rotates about its stationary shaft the four chains walk around the stationary sprockets. This causes changes in the relative positions of frame, mills and grinding bodies as shown in the sketch.

▶ **Cascading Is Out**—Because of this unique action there is appreciable centrifugal force holding the grinding bodies and material being ground firmly against the mill wall. There is said to be no tumbling or cascading of balls dropping from a high point on the wall to a lower level. Rather they are sliding or rolling in close contact with each other and the mill wall at all times.

▶ **The Record**—What this means in grinding efficiency is revealed by some typical grinding times. To grind tungsten carbide down to 3-5 microns normally takes 120 hr. With the Hyswing mill it can be done in 8 hr. And hitherto unattainable fineness can be reached within 20 hr.

Some other materials and times are: titanium dioxide, maximum fineness in 20 min.; mica, 0.5 microns in 3 hr.; barium sulfate, to triple volume in 3¼ hr.; sulfur, from ¼ in. to 2 microns in 2-3 hr.; chromium oxide, from commercial size to five times initial volume in 9 hr.

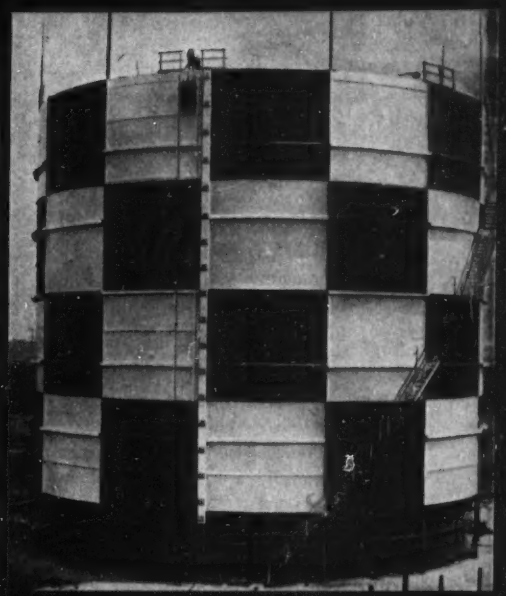
The Hyswing mill is presently available in two sizes: B-1 having four containers with 5 liter internal volume, and C-1 having four containers with 50 liter internal volume.

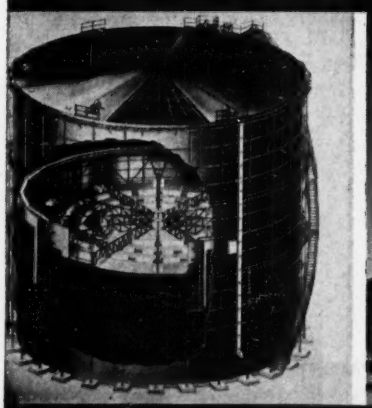
Containers can be furnished in steel, ceramic or any specified ma-

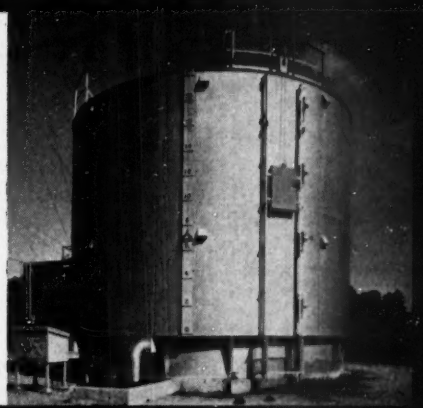
simple! proved in use!

Wiggins Gasholder

BY GENERAL AMERICAN





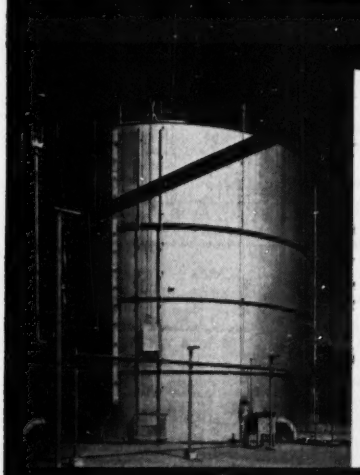


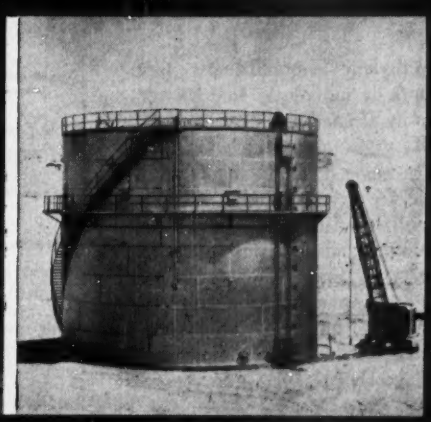
The only gasholder that uses

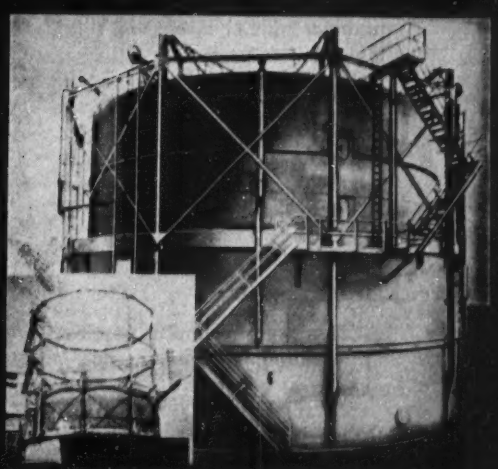
NO WATER
NO TAR
NO GREASE

The only gasholder that assures you

NO WEATHER WORRIES
NO OPERATING COSTS
NO MAINTENANCE PROBLEMS







You can convert your old style gasholders to get the Wiggins advantages

GENERAL AMERICAN

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Be sure to get the performance record on the only modern gasholder before you plan any gasholder construction.

Equipment on These Pages This Month Made News . . .

Page Number is also Reader Service Code Number

New Processing Equipment
- Ball Mill 266A
- Flocculator 268A
- Filter Cloth 268B
- Filter Cloth 268C

New Electrical & Mechanical Equipment
- Gas-Filled Motor 270A
- Worm Reducer 270B
- Starters 270C
- Belt Idlers 270D
- Dry Bearing 270E
- Belt Drive 272A
- Aluminum Bus Bars 272B
- Solar Battery 272C

New Materials of Construction
- Cellular Glass Insulation 274A
- Protective Coating 274B
- Heat Transfer Media 274C
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New Fluids Handling Equipment
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- Pump 278A
- Valves 278B

New Instruments & Controls
- TV Camera Box 280A
- Pneumatic Transmitter 280B
- Portable X-Ray Unit 280C
- Recording-Controller 280D
- Ion Exchanger Control 282A
- Density Meter 282B
- Receiver-Integrator 282C

New Packaging & Handling Equipment
- Aluminum Semi-Trailer 284A
- Feeder 284B
- Bin Discharger 284C
- Plastic Trailer 284D
- Collapsible Steel Box 284E

. . . For more details, use Reader Service Card on page 427

terial. Removal from machine of drums with finished charges and replacement with reserve drums ready for grinding takes about three minutes.

The B-1 machine driven by an 1140 rpm. motor has a rotational speed of approximately 250 rpm. Electrical equipment is explosion-proof.—**Wiwoco Corp., 76 Beaver St., New York 5, N. Y. 266A**

Flocculator

For water treatment, improves conditions for forming floc.

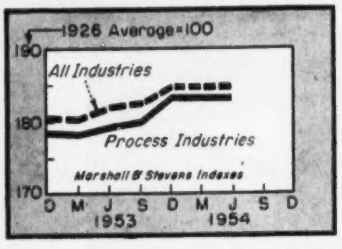
The Spirol-Mix flocculator for conventional water treatment plants is claimed the only unit that provides all three of the following functions: a.) avoids short circuiting of flow, b.) provides decreasing rate of agitation as floc forms, c.) produces uniform roll-mix action in the same direction as the water flow.

Unit is a vertically-mounted-agitator with variable-speed drive. Arrangement and pitch of the blades causes a decrease in the rate of agitation as the water rises in the basin. **—Graver Water Conditioning Co., 216 West 14th St., New York, N. Y. 268A**

Polyethylene monofilament filter cloth is inherently free flowing, easily cleaned and slow to blind. Moisture absorption factor is less than 0.01%. It resists attacks from molds, mildew, moths and sunlight; most acids, common alkalis, certain organic solvents and oxidizing agents, most aqueous salt solutions, mineral and vegetable oils.—**National Filter Media Corp., New Haven 14, Conn. 268B**

Teflon filter cloth offers advantages of high service temperature and chemical inertness. It is attacked only by fluorine gas, molten alkali metals and tri-chlorine fluoride. Moisture absorption is 0.0% and cloth is wholly resistant to mildew and sunlight.—**National Filter Media Corp., New Haven 14, Conn. 268C**

EQUIPMENT COSTS . . .



Process Industries	Mar. 1954	June 1954
Cement mfg.	177.8	178.0
Chemical	186.4	186.6
Clay products	172.6	172.8
Glass. mfg.	176.2	176.4
Paint mfg.	179.5	179.7
Paper mfg.	179.8	180.0
Petroleum ind.	183.0	183.2
Rubber ind.	185.4	185.6
Related Industries		
Elec. power equip.	188.3	188.5
Mining, milling	187.4	187.6
Refrigerating	205.1	205.3
Steam power	175.7	175.9

Compiled quarterly by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. See *Chem-Eng.*, Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1954, pp. 214-5 for annual averages since 1913.

which of these do you handle?

ACIDS (INORGANIC & ORGANIC)	Recommended H R = Hard Rubber S R = Soft Rubber	Maximum Temperature, deg. C.
Acetic	HR	70
Acetic Anhydride	HR	70
Arsenic	HN-SR	70
Boric	HR-SR	70
Citric	SR	40
Formic	HR	70
Hydrobromic	HR-SR	70
Hydrochloric	HR-SR	70
Hydrofluoric (up to 50%)	HR-SR	70
Hydrofluosilicic	HR-SR	70
Hydrogen sulphide water	HR	70
Lactic	HR	Room Temp.
Nitric (up to 20%)	HR	70
Oleic	HR-SR	70
Oxalic	HR-SR	70
Phosphoric (up to 85%)	HR	70
Salicylic	HR	70
Stearic	HR-SR	70
Sulphuric (up to 50%)	HR	70
Sulphurous	HR-SR	70
Tartaric	HR-SR	
Tannic		

SOLUTIONS OF INORGANIC SALTS AND ALKALIES	Recommended H R = Hard Rubber S R = Soft Rubber	Maximum Temperature, deg. C.
Sodium (or potassium) hydroxide	HR-SR	70
Sodium (or calcium) hypochlorite	HR-SR	70
Sodium sulphate	HR-SR	70
Sodium (or potassium) sulphide	HR-SR	70
Sodium (or potassium) sulphite	HR-SR	70
Sodium thiosulphate	HR-SR	70
Stannic chloride	HR	70
Stannous chloride	HR-SR	70
Sulphite Liquors	HR-SR	
Zinc chloride		
Zinc sulphate		
HALOGENS		
Chlorine (dry) at low pressures	HR-SR	70
Chlorine water (hypochlorous acid)	HR-SR	70

SOLUTIONS OF INORGANIC SALTS AND ALKALIES		
Aluminum chloride	HR-SR	70
Aluminum sulphate	HR-SR	70
Alums	HR-SR	40
Ammonium hydroxide	HR	70
Ammonium sulphate	HR-SR	70
Barium chloride	HR-SR	70
Brine (acid)	HR-SR	70
Calcium bisulphite	HR	70
Calcium chloride	HR-SR	70
Calcium hydroxide	HR-SR	70
Cupric sulphate	HR	70
Cupric chloride	HR-SR	70
Ferric chloride	HR-SR	70
Ferric sulphate	HR-SR	70
Ferrous chloride	HR-SR	70
Ferrous sulphate	HR-SR	70
Magnesium chloride	HR-SR	
Mercuric chloride		
Plating solutions: Brass, Cadmium, Copper, Gold, Lead, Nickel, Silver, Tin, Zinc	HR-SR	70
Potassium Dichromate	HR	70
Sodium (or potassium) bisulphate	HR-SR	70
Sodium (or potassium) bisulphite	HR	70
Sodium cyanide	HR-SR	70

ORGANIC MATERIALS		
Acetaldehyde	HR-SR	70
Acetic anhydride	HR	70
Acetone	HR-SR	70
Alcohols	HR-SR	70
Ammonium Thioglycolate	HR	70
Amyl, butyl, ethyl acetates	HR-SR	70
Aniline hydrochloride	HR-SR	70
Casein	HR	70
Castor Oil	HR	70
Cocoanut Oil	HR	70
Cottonseed Oil	HR	70
Dyestuffs	HR	70
Ethers	HR-SR	70
Ethylene glycol	HR-SR	40
Formaldehyde (up to 40%)	HR	40
Furfural	HR	70
Fruit juices	HR-SR	70
Glucose	HR-SR	70
Glycerine	HR-SR	70
Ketones	HR-SR	70
Milk	HR	40
Mineral Oils	HR	70
Olive Oil	HR	70
Soaps	HR	70
Triethanolamine	HR-SR	70
Vinegar	HR	

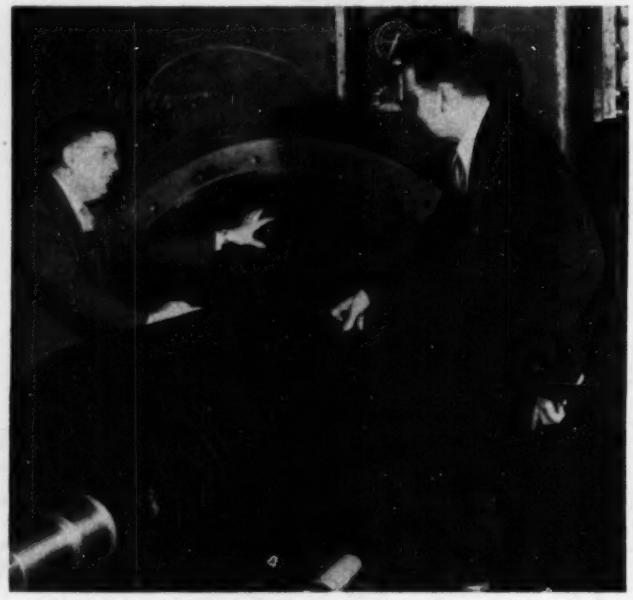
. . . these are jobs for ACE® RUBBER-PROTECTED EQUIPMENT

. . . and this is only the beginning. This list represents only a few of the actively corrosive solutions which can be handled economically by Ace rubber protected equipment. Ace Tempron, Neoprene, nitriles, copolymers and Ace Thermoplastics such as saran, polyethylene, etc., extend this range still further.

Ask our engineers to recommend the most economical corrosion-resistant equipment for your processes.

ACE rubber and plastic products

AMERICAN HARD RUBBER COMPANY
93 WORTH STREET • NEW YORK 13, N. Y.



Gas-Filled Motor Will Power Compressor

Believed to be the world's most powerful inert-gas filled motor this unit will keep things moving in a large cat cracker. The 7,700 lb. rotor is being examined while under construction at G-E Schenectady. Motor will drive a new centrifugal gas compressor on a catalytic cracking unit at Sohio's No. 1 refinery, Cleveland, Ohio. It replaces eight reciprocating engines; is expected to eliminate excessive building vibration, reduce maintenance, increase production and improve safety.—General Electric Co., Schenectady 5, N. Y. 270A

Worm Reducer

Has fluid coupling for smooth starting.

To provide smooth gradual acceleration a new worm type speed reducer is built with a fluid coupling. It is especially adapted to powering mixers, conveyors, centrifugals, cranes, etc.

In addition to the cushioned-power-gear-reducer features the unit is unusually compact in comparison to helical gear reducers. Also it can be mounted in 16 different positions which permits installation in tight, hard-to-get-at places.

Fluid-coupled worm reducers are available in range of hp. and frames from ½ to 2 hp. Speed reductions are from 24 to 140 rpm.—**Reuland Electric Co., Alhambra, Calif. 270B**

Starters

For hazardous atmospheres and corrosive service.

A new line of Class I Group D motor starters is intended for use where hazardous atmospheres and severe corrosive conditions are encountered. For maximum protection against explosion and corrosion, all connections, terminals, arcing parts and main line disconnect switches are immersed in oil.

Starters are of Valimitor (volt-ampere-limitor) type. Over-all short circuit protection is provided for 2,200-5,000-v. motors, irrespective of the magnitude of the fault or of the available capacity. Actual rating is 50,000 kva. interrupting capacity.

These starters are suitable for use with high inrush motors. Also with thermal capacity equalling or surpassing the average motor, they can withstand frequent starting.—**Electric Controller & Mfg. Co., 2713 East 79th St., Cleveland 4, Ohio. 270C**

Belt Idlers

Have new seal design that retains grease, keeps dirt out.

Jeffrey's new line of MD and HD series belt idlers feature the new Duoflex seal. This dual, flexible, contact-seal keeps out dirt and retains grease for a claimed endless period of time. Since idlers are factory packed, adjusted and sealed they are classed as permanently lubricated.

An added feature is neoprene shaft connectors. They permit regreasing from either end when and if desirable. Rolls are removed easily without loosening or removing the stands.

End stands have 2 deg. tilt for engineered belt training; tend to give the center roll of the troughing idler more control over the belt.—**The Jeffrey Mfg. Co., Columbus 16, Ohio. 270D**

Dry Bearing

High density graphite-bearing alloy works without lubrication.

Deva alloys work as bearing surfaces without lubrication under high pressures from −200 to +700 C. Available either as copper, iron or aluminum base materials these alloys have unique high density properties; can be furnished with high degrees of Brinnel hardness.

For chemical industry needs

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

How to remove the silver lining!

There's big money in the valuable dust hidden in the smoke that goes out of your plant's chimney. Buell can help you recover that profit-laden dust quickly and economically... convert it into a brand new source of income.

How much? Many Buell Dust Collection Equipment Installations are recovering as much as 40 tons of valuable dust *daily*. You can see, it soon adds up into real money. During the past twenty years, Buell specialists have developed three different types of dust collection equipment. The right equipment to handle *any* dust collection problem.

That's why dozens of America's leading corporations depend on Buell to solve dust collection problems of all kinds. We will be glad to supply the names of many such users right in your own field!

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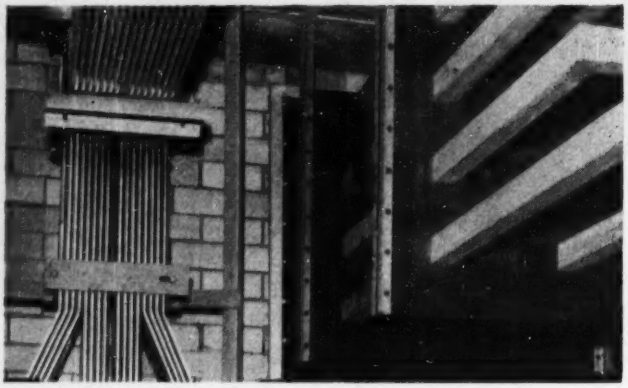
20 Years of Engineered Efficiency in
DUST COLLECTION SYSTEMS

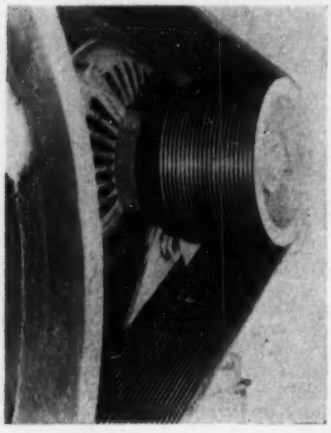
other types of alloys are available. And the complete absence of lubricants is desirable for such applications.

The performance of Deva alloys as bearing surfaces is due to the presence of a continuous graphite film that forms as the surface runs in. The graphite is an intimate part of the alloy which is formed under high pressure and temperature by powder metallurgical techniques.—**Neumann & Welchman, Inc., 22-12 Raphael St. Fairlawn, N. J.** 270E



Aluminum Bus Bars in New Chlorine Plant

Here you see two types of aluminum electrical conductors installed in a new electrolytic chlorine plant of Solvay Process Div., Allied Chemical & Dye Corp. On the left are rectangular bus bars, ¼ x 10 in.; on the right overhead are 4-in. hollow, square, tubular conductors with ¼-in. walls.—Aluminum Co. of America, 1501 Alcoa Bldg., Pittsburgh 19, Pa. 272B



Belt Drive

Combines in one belt all the features of a set of matched V-belts.

The Poly-V belt is a single, endless rubber belt that performs the same job done by a set of matched V-belts. However, it handles up to 50 percent greater horsepower with the same width or equal horsepower with ¼ less sheave width. Both belt and sheave are claimed to have longer life than conventional v-belt drives.

Parallel V ribs are molded lengthwise around the inside circumference of the belt. In addition it has an uninterrupted, high-strength member of synthetic cords across its entire width.

An important feature of the Poly-V drive is the elimination of problems associated with belt matching which are common to multiple V-belt applications. Also, it affords a marked economy in belt and sheave inventories.—**Manhattan Rubber Div., Raybestos-Manhattan, Inc., Passaic, N. J.** 272A

Solar Battery

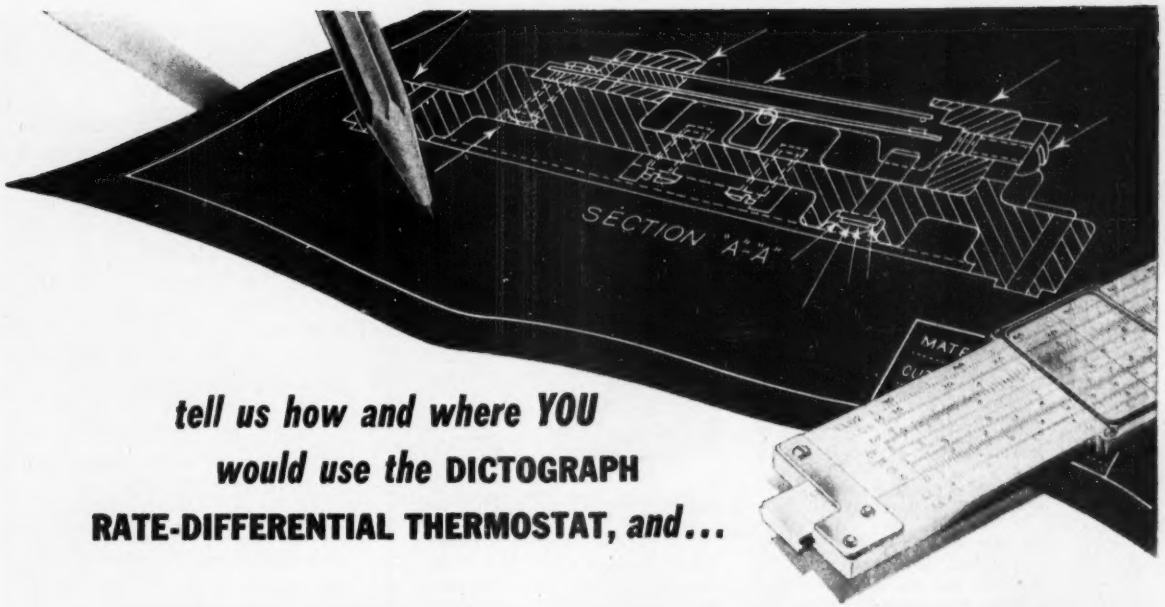
Is first successful device to convert sun's rays to useful amounts of power.

Sunlight is providing the power to turn this motor-driven wheel. The solar battery in the left hand converts energy from the sun directly into electricity. It is a new short cut for getting electricity that bypasses chemical, hydro or steam conversions.

Bell's new battery is the first device to convert solar energy into useful quantities of electricity. Operating at 6 percent efficiency the battery compares favorably with the efficiency of steam and gasoline engines. Previous photoelectric devices have never been rated higher than 1 percent.

Battery is still in the experimental stages but is already producing power at the rate of 50 w. per sq. yd. of surface. With improved techniques the efficiency is expected to be boosted substantially over the first units.

Wafer-thin strips of silicon about the size of common razor blades convert the light to electricity. The extreme light-sensitiveness of the silicon depends upon the presence of minute amounts of impurities in the atomic structure at the surface of the silicon. This makes a "p-n junction" similar to that in the now-familiar germanium transistor. **—Bell Telephone Laboratories, 463 West St., New York 14, N. Y.** 272C



tell us how and where YOU would use the* DICTOGRAPH RATE-DIFFERENTIAL THERMOSTAT, *and...

WIN UP TO $1,000

Dictograph . . . world leader in precision detection devices, has just developed the most advanced thermostat available today. There are so many possible uses for this remarkable invention, we're sure we've overlooked some. We think you might be able to help us. If so, you can win up to $1,000 cash. We simply want *your* suggestions of "places to use" the *Dictograph Rate-Differential Thermostat* . . . or the R-D.

THIS IS WHAT THE DICTOGRAPH R-D DOES!

Most good thermostats will go into action at a specific pre-set temperature. But ONLY the *Dictograph R-D thermostat* can be set to operate at both a pre-set temperature and any specific *rate of temperature change*. For example, if the Dictograph R-D is calibrated to operate at a temperature increase of 15° per minute, and the temperature goes from 45° to 60° (or any other 15° differential) within one minute, the Dictograph R-D will function.

This means, for example, that you can now operate machinery, motors, test equipment, etc. without the safety margin required with "fixed temperature only" thermostats, because the Dictograph R-D will warn you as soon as the danger condition *starts*.

In addition, the Dictograph R-D will perform flawlessly regardless of the medium in which it is used . . . submerged in liquids, encased in solids, or suspended in air or gas. It can be changed in size and shape to fit almost any requirements, and calibrated to detect almost any temperature differential.

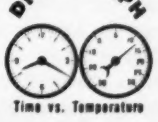
THIS IS WHAT YOU DO TO WIN $1,000!

Just tell us where you think the Dictograph R-D could be effectively used, either in your industry, or any other field. Put your suggestions in a letter . . . if necessary attach drawings or diagrams. If our engineering panel decides that your suggestion is the most practical and purposeful, *YOU WIN $1,000*. Ten other awards of $100 each will be made for the next ten most practical and purposeful suggestions. There is no limit to the number of entries you can make. (see contest rules below) But all letters must be postmarked before midnight, August 31, 1954 to be eligible.

WRITE US TODAY!

CONTEST RULES

1. All persons now residing in the United States or Canada are eligible, except members of Dictograph Products, Inc., their Advertising Agencies, and their families.
2. All suggestions must be in letter form, and addressed to:
   R-D Contest Department
   Dictograph Products Inc.
   95-25 149th St.
   Jamaica 35, New York
3. There is no limit to the number of suggestions.
4. All letters must be postmarked by midnight, August 31, 1954.
5. In the event that duplicate ideas are submitted, the one bearing the earliest postmark will receive consideration.
6. All letters, entries and modification of entries become the property of Dictograph Products Inc., and cannot be returned.
7. Entries will be judged by The Dictograph Engineering Department. All decisions are final.



Dictograph

Factory and Offices, Jamaica 35, N. Y.

Putting Cellular Glass Insulation on the Ball

In this case "the ball" is the giant sphere that houses the elaborate test cell for an atomic submarine. Measuring 225 ft. in dia. and enclosing 5½ million cu. ft. the airtight sphere must be guarded against internal fluctuations of temperature and pressure that would impose hazardous structural stresses. Foamglas cellular glass insulation does the job. It is applied in the form of blocks with dimensions of 2 x 12 x 18 in. Each block is impaled on two steel pins welded to the steel shell. Clips fastened to the pins hold the blocks in place. Asphalt cutback is used between blocks and shell, also for exterior finish on blocks. — Pittsburgh Corning Corp., One Gateway Center, Pittsburgh 22, Pa. 274A

Protective Coating

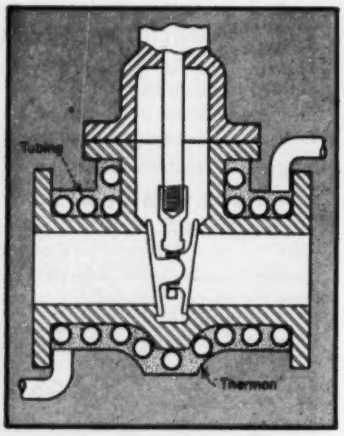
Based on neoprene can be brushed or sprayed.

A tough, adherent protective coating can be obtained by applying Magic-Vulc neoprene maintenance coating No. 245-B to surfaces under exposure. It resists the action of oils, alkalis, strong sunlight, sea water and many other troublesome corrosive conditions.

Applied directly from the can, coating No. 245-B dries within 2 hr. to a dry film thickness of 5-10 mils. One gal. covers 75-100 sq. ft.

Coating will adhere to metal, concrete, wood, plastic, glass and other surfaces. It resists water and chemical solutions under conditions of total immersion.

Among the many uses of the coating are protection of steel structures and equipment, anti-skid coating, caulking and sealing compound, formed-in-place gaskets, repairing worn conveyor belts, lagging pulleys and protection and repair of electrical equipment.—**Magic Chemical Co., Dept. N-18, 121 Crescent St., Brockton, Mass. 274B**



Heat Transfer Media

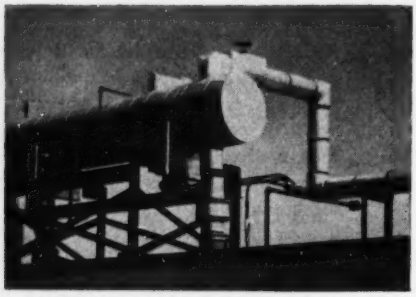
Aids in applying external heat to fittings, piping and vessels.

Molten or liquid materials that are highly viscous at normal temperatures may need special care in handling to avoid freezing and plugging. The usual remedy is to apply external heat to vessels, piping and fittings through use of jacketing or tracing.

Disadvantages inherent in these methods are claimed to be overcome through use of Thermon heat transfer media. Used in conjunction with conventional steam tracing it permits elimination of jacketing in a majority of cases. Savings over equivalent jacketed equipment are said to run 50 to 60%.

The Thermonizing process consists of installing the required kind and quantity of tubing on the equipment (piping, pumps, valves etc.). Thermon material is then mixed and applied over the coils, as shown, so that tubing and exposed surfaces of the equipment are thoroughly covered.

After the Thermon has partially set it is finished to the appearance of a sand casting. Desired mechanical and thermal properties are obtained by baking under controlled conditions. A heat resistant finish is applied to complete the job.—**Thermon Mfg. Co., P. O. Box 3027, Pasadena, Tex. 274C**



Aluminum Jacketing

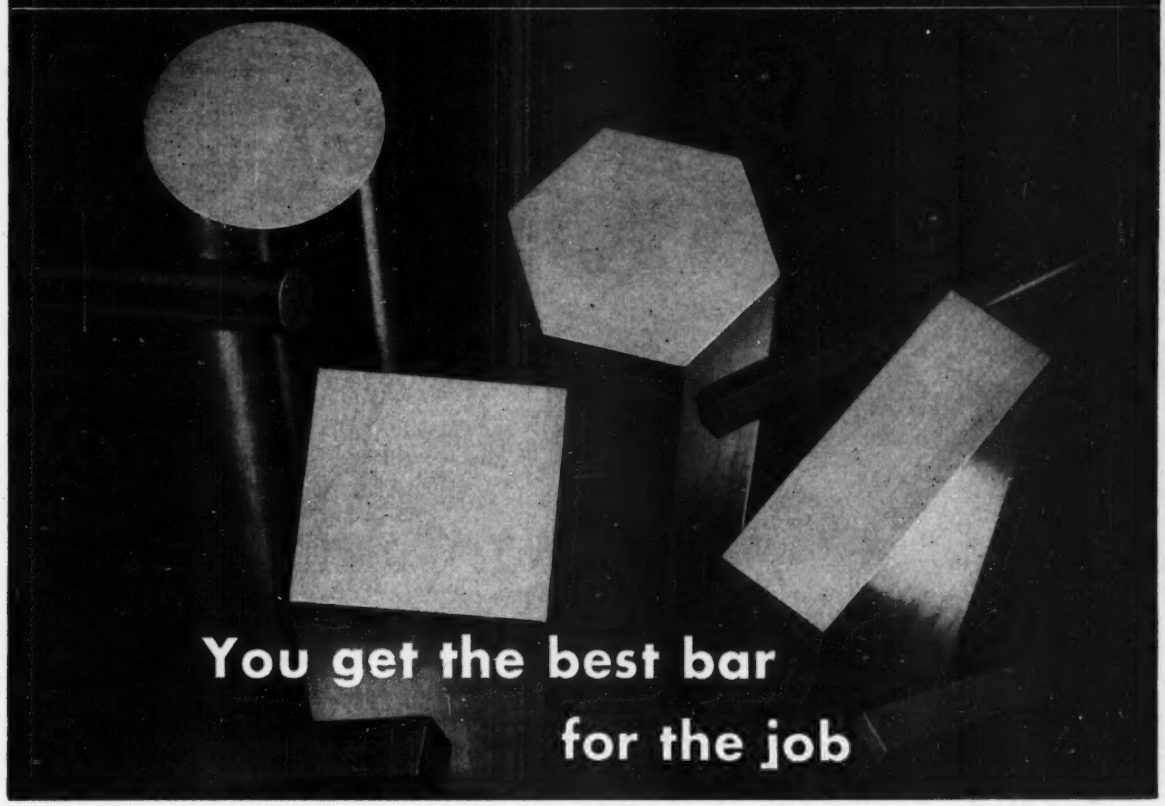
Protects insulation on pipes and equipment.

Low cost protection for insulated pipelines and equipment, both inside the plant and outdoors, is provided by Al-Cor-Jac sheet aluminum jacketing.

Material is furnished in corrugated form, either with or without a vapor barrier. It is light and easy to handle, installs with speed and ease. Fastening can be chosen from staples, tapes, bands or screws.

No painting is necessary which reduces maintenance. During cleaning operations pipelines and equipment covered with the jacketing can be hosed down with the rest of the plant.—**Aljon Mfg. Co., Inc., Chestnut St. and Highland Pkwy., Roselle, N. J. 274D**

WHY IT PAYS TO BUY COLD FINISHED BARS FROM US



• Our experienced technical staff will help you determine what grade of cold finished bar would best help cut costs in *your* shop. Often, you can realize great savings by not overbuying quality . . . the best bar for the job is *not* necessarily the most expensive.

The large, ready-to-deliver stocks in all our warehouses include a wide variety of types in the sizes and shapes most commonly used. These cold finished bars are produced under exacting quality control by the world's foremost steel manufacturer —United States Steel.

When you want the best in cold finished bars, combined with sound technical assistance and prompt delivery, call your nearest U. S. Steel Supply warehouse. We carry: cold finished rounds, squares, hexagons, flats and precision shafting in all grades; cold finished screw stock, Bessemer rounds, "MX" high speed screw stock.

TRIPLE SECURITY

What you want
When you want it
At the right price

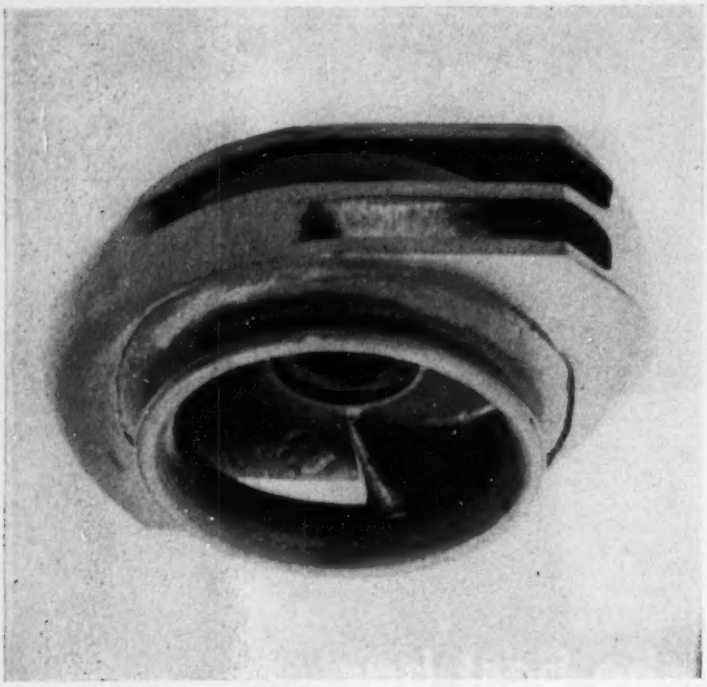
U. S. STEEL SUPPLY
DIVISION

General Offices
208 So. La Salle St., Chicago 4, Ill.

Warehouses and Sales Offices Coast to Coast

USS STEEL — UNITED STATES STEEL

UNITED STATES STEEL



IMPELLER sucks axially from top and bottom, discharges radially on . . .

MIXER that is built to give . . .

A High Degree of Turbulence

It's aimed at broadening the range of mixing obtainable with one impeller. Twelve months of testing have shown new mixer can handle a wide variety of jobs.

Turbulence, created by the RKM mixer, swirls throughout the container, intimately mixing the entire contents. Best of all it is done without channeling or loss of energy in wasteful, simple circulatory rotation.

▶ **Writing Performance Record**—Field tests over the past year have confirmed the hopes of the designers when they undertook development of this unit. What they were after was a broad-range mixer, able to exert strong suction both above and below to draw materials into the primary mixing zone. Here are some of the jobs cited by the manufacturer as readily handled by the RKM during the field trials:

• Lacquer—On heavy viscosity (2,000-3,000 cps.) mixtures the RKM was said to give uniform mixing where formerly a modified propeller mixer could handle only reduced volume with the aid of recirculation.

• Heavy liquids—Able to produce uniformity in a mixture of viscous liquids (3,000 cps. @ 73 C.) which normally would settle into layers.

• Paper pulp—Mixed intensively a tank full of pulp at 5¼% consistency.

• Corn starch—Within minutes resuspended starch that over an 8-day period had formed a thick, heavy surface layer.

• Gas-liquid mixing—Did an effective job of de-gassing spin bath to remove hydrogen sulfide contaminant.

• Light solids—Maintained uniform suspension of foam rubber cubes in water.

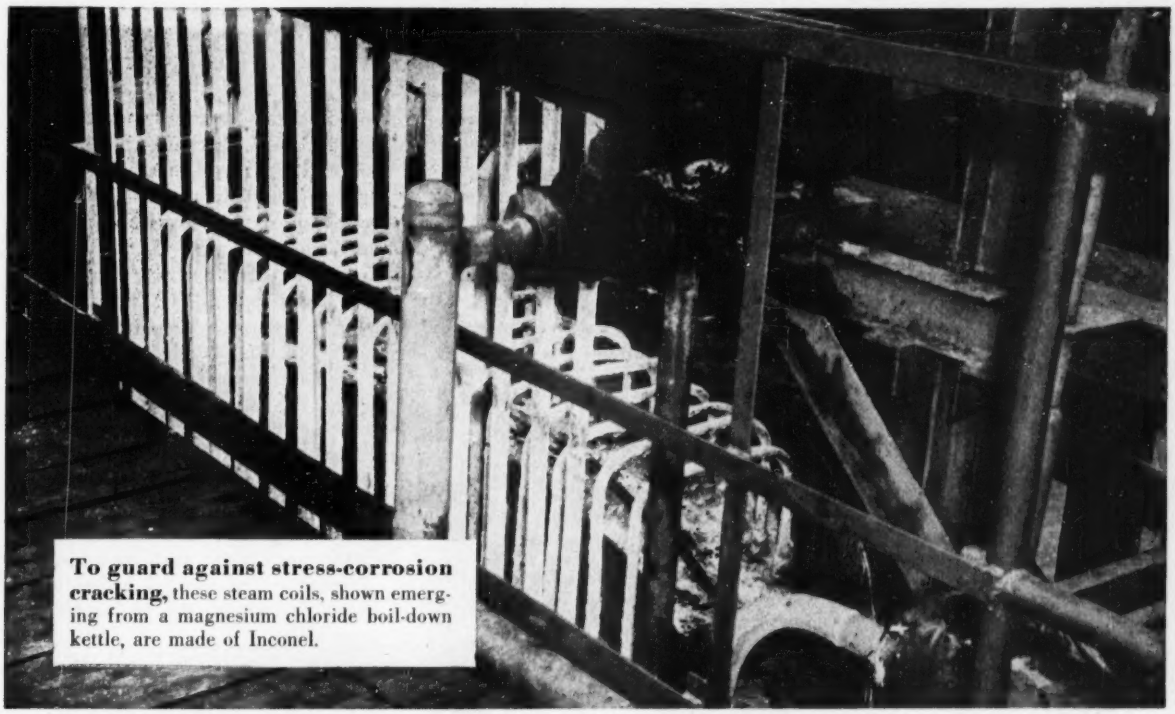
▶ **Blood Brother of Pump**—When you take your first glance at the RKM impeller you may think you are looking at a pump impeller. It is a natural reaction because this mixer impeller works somewhat like a double-suction centrifugal pump.

The impeller is a closed type with walls at top and bottom and a dividing partition in the center. The upper and lower (see illustration) chambers thus formed have axial intake openings and flow channels for radial discharge.

With axial flow intake openings

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.



To guard against stress-corrosion cracking, these steam coils, shown emerging from a magnesium chloride boil-down kettle, are made of Inconel.

HANDLING CHLORIDES?

Here's how Inco Nickel Alloys are being used today to protect equipment against chloride corrosion.

Take the magnesium chloride concentration operation shown here, for example.

Those steam coils have to withstand general attack by the hot, highly corrosive 34% to 48% solution. Even more important, they must successfully resist stress-corrosion cracking, which is enthusiastically promoted by magnesium chloride.

Inconel does the job. In magnesium chloride solutions, Inconel shows no tendency toward stress-corrosion cracking and its corrosion rate is usually on the order of only 0.001 in. per year or less.

What about alkaline or neutral salts such as sodium or calcium chloride? Monel is commonly used for major items of refining equipment . . . even in rotary driers where temperatures go up to 350° F. Where solid salt contacts metal surfaces for extended periods . . . or where absolute freedom from copper is desired, Inco Nickel is usually employed.

In acid salts, such as zinc chloride or ammonium chloride, the Inco Nickel Alloys also exhibit valuable corrosion-resistance. Nickel and Monel have a corrosion rate of the order of only 0.02 in. per year in the boiling concentrated solutions and are therefore used in evaporator equipment.

In the manufacture and transportation of phosphorus oxychloride and trichloride and of nitrosyl, benzyl, acetyl, and benzoyl chlorides, Nickel is widely used. After twelve years use in separating chlorine from nitrosyl chloride, a Nickel rectification tower showed no appreciable corrosion.

If you have a corrosion problem involving the handling of chlorides, write to Inco's Corrosion Engineering Section. They will be glad to help you without cost or obligation.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

Inco Nickel Alloys

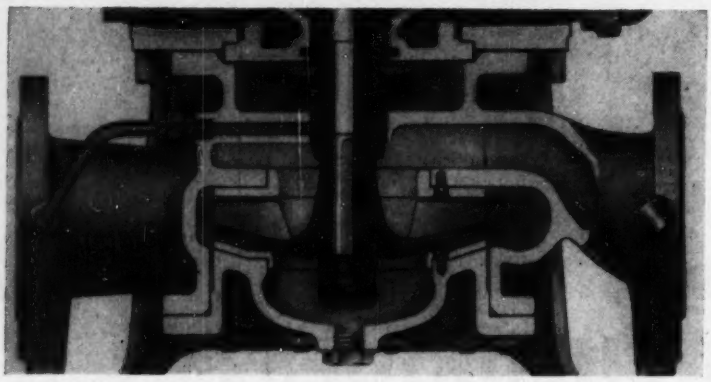
INCO TRADE MARK

Monel® • "R"® Monel • "K"® Monel • "KR"® Monel "S"® Monel • Inconel® • Inconel "X"® • Inconel "W"® Incoloy® • Nimonic® Alloys • Nickel • Low Carbon Nickel Duranickel®

at both top and bottom of the impeller equally powerful suction forces are exerted on the liquid surface and the bottom of the vessel.

The oval outline of the impeller together with the design of the internal flow passages vary the mixing action so that the liquid pulsates against the central shaft while being slung radially outward from shaft.

Double bearings support the rotating mixer. The lower long bearing is close to the impeller; can be lubricated by the fluid in the container, or by externally supplied water or grease.—**Neumann & Welchman, 22-12 Raphael St., Fair Lawn, N. J.** 276A



Pump Sealed by Liquid Ring

In Sweden they've come up with a new centrifugal pump that is sealed, while running, by a hydrodynamically-balanced liquid ring. Close running clearances have been eliminated along with resultant wear on sealing surfaces. During shutdown, system pressure is sealed within pump by a patented diaphragm seal that only contacts the shaft while it is stationary.

These features of the Nobox pump makes it a sure bet to lick many difficult pumping jobs involving abrasive and corrosive liquids. Absence of rubbing seals means wear-free corrosion-resistant surfaces.

Liquid being pumped can be used for sealing even if it has a high solids content—up to 55-60%. The Swedish pulp industry uses a large number of Nobox pumps to handle sulfate and sulfite liquors with this concentration of solids.

▶**Seal on Suction Side**—The Nobox pump is a vertically-mounted top-driven unit that can be dismantled without removing the motor or motor stand. Sealing is completely on the suction side of the pump. In place of the conventional stuffing box there is a separate sealing chamber with an auxiliary sealing impeller. Rotation of the impeller maintains a liquid ring inside the chamber that keeps liquid from leaking out and air from leaking in.

In the picture are seen the pump casing and pump impeller with suction inlet on the right and discharge on the left. Above the impeller within the sealing chamber is mounted the auxiliary impeller. Just above the auxiliary impeller is found the diaphragm seal that operates automatically during shutdown.

▶**How Seal Works**—Both top and bottom of the auxiliary impeller are provided with pumping vanes; in effect it is a double impeller. When the suction side of the pump is under negative pressure the lower set of auxiliary vanes controls the sealing fluid, holding it against the atmospheric pressure acting from above. In this instance upper vanes are a secondary control. Being of larger diameter they prevent loss of fluid upward along the shaft.

▶**Balance Point Reached**—What takes place actually is that the lower vanes tend to force the sealing liquor upward while atmospheric pressure and the upper vanes force it in the opposite direction, downward. A balance point is reached within the chamber so that the liquid does not move in either direction while pumping conditions remain constant.

When there is positive pressure on the suction side of the pump the upper vanes of the auxiliary impeller balance the upward hydraulic thrust to establish the sealing balance point.

Either the system liquid or a separate liquid can be used for sealing. The only losses, which are small, are through evaporation.

Pumps operate over a wide range of pressures, vacuums and temperatures. They are available in three standard series for varying ranges of capacity and head.—**Jonkopings Mekaniska Werkstads Aktiebolag, Jonkoping, Sweden.** 278A

Valves

Resist corrosion and check high costs.

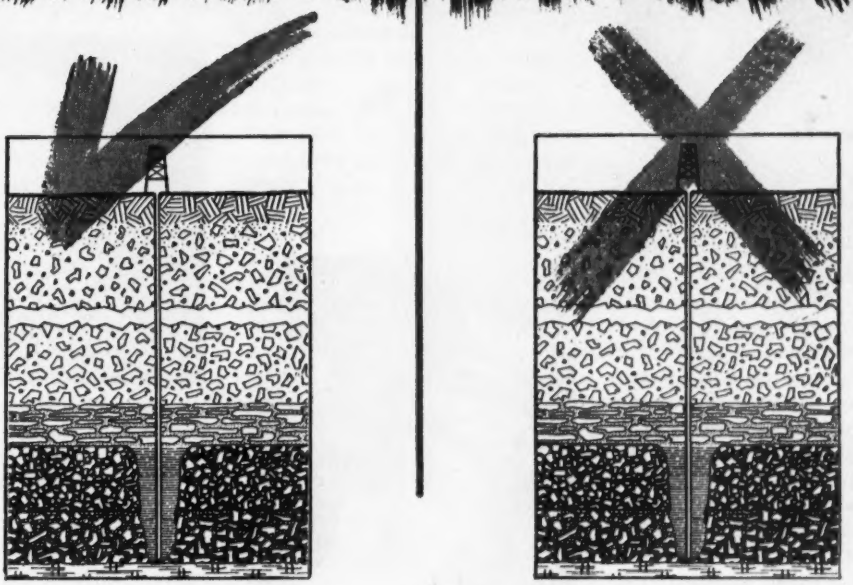
A new line of Ni-Resist valves is designed specifically to checkmate the high cost of corrosion. They are adapted for handling pulp and paper mill liquors, oil refinery acids, alkalis and sludges, caustic soda, pickling solutions, sea water and many other liquids.

Ni-Resist alloy possesses far greater corrosion and heat resistance than ordinary cast iron. In many respects similar to gray cast iron and resembling stainless steel the metal offers a unique combination of useful properties.

Valve users will have available from this one manufacturer not only corrosion-resistant valves but also all types of bronze, iron, steel and lubricated plug valves.—**The Wm. Powell Co., 2525 Spring Grove Ave., Cincinnati, Ohio.** 278B

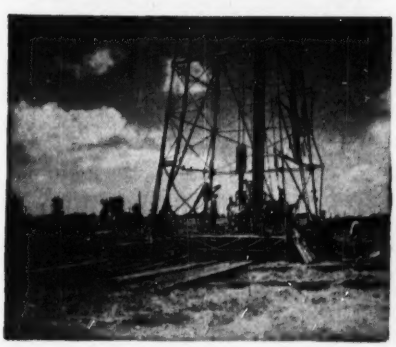
SULPHUR

...why can't *Every* dome produce sulphur?



The production of sulphur in the Gulf Coastal Region of Louisiana and Texas by the Frasch Process, is from underground natural beds found in "domes." However, very few domes have been found to contain sufficient sulphur, if any, to be brought into production.

It is estimated that nearly 200 dome structures along the Coast of the Gulf of Mexico have been investigated over the last half-century but only fourteen have produced sulphur in quantity.



And the presence of sulphur, even in quantity, doesn't always mean a successful producer. Some years ago a dome was found, explored, and proved with the result that a plant for the production of sulphur was erected at a cost of several million dollars. Later it had to be abandoned because the underground conditions did not lend themselves to the use of the Frasch Process.

A dome is a sulphur mine only when it can be worked economically and produce sulphur in commercial quantities.

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.

Sulphur Producing Units

- NEWGULF, TEXAS
- MOSS BLUFF, TEXAS
- SPINDLETOP, TEXAS
- WORLAND, WYOMING

TV Camera Box

Protects camera from cold, heat, rain and snow.

A new all-weather aluminum housing makes possible the installation of industrial TV cameras out-of-doors, in hazardous plant locations and at unsafe test or experimental areas. Typical new uses will include remote traffic control in railroad yards, viewing high-temperature processes such as carried out in furnaces, and safe-distance regulation of hazardous operations such as found in chemical plants and in nuclear research.

Tripod-mounted insulated box has thermopane window through which the camera takes pictures. Window has remote-controlled windshield wipers on both inside and outside to prevent rain or condensation from obscuring the view.

Electric ribbon heaters, mounted inside the walls of the box, are turned on thermostatically when the temperature drops below 40 F. Above this temperature a fan goes on automatically. Air is filtered through the bottom of the box and is exhausted through the back.—**Tenney Engineering Co., Union, N. J.** 280A

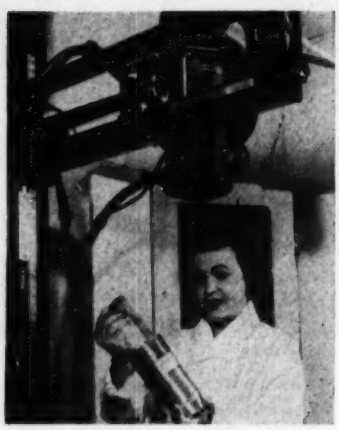
Pneumatic Transmitter

Universal model for telemetering and control systems.

Pneumatic telemetering and control systems now can be simplified by the use of a new universal transmitting unit. It transmits measurements of flow, level, pressure, temperature, draft, differential and vacuum.

The measuring element actuates the transmitter's micro-sensitive vane, nozzle and booster assembly. Transmitted signals of 3-15 and 3-27 psig. can actuate pneumatic receivers and/or controllers. Both the measured variable and pneumatic signal are indicated on a common scale for easy checking and comparison.

Transmitting distances can be 1,000 ft. to receivers and 400 ft. to controllers. Accuracy is within ± ½% of measured range span, and air consumption is less than 0.15 cfm.—**Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio.** 280B



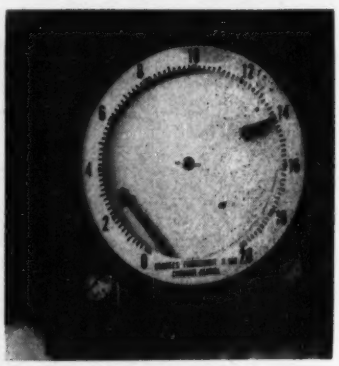
Portable X-Ray Unit

Comparable to 100,000 v. machine weighs less than ten pounds.

Compare the size of the new X-ray unit in the young lady's hand with the standard machine shown. That small canister can emanate X-rays equal in energy to those from a 100,000-v. X-ray machine. It's a potential inexpensive source of X-rays for both medical and industrial use.

The new unit does not require any electrical power supply. A tiny particle of radioactive thulium (a rare earth element) produces the radiations needed for X-ray photographs. A shutter mechanism to control release of the radiation is operated by a standard photographic cable release.

Exclusive of irradiation charges the total cost of the first unit built was only $40. Industrially it has potential use for determining density and liquid levels in closed systems. And possibly (Editor's opinion) the unit could be adapted to examination of welds on process equipment units.—**Argonne National Laboratory, P. O. Box 299, Lemont, Ill.** 280C



Recording Controllers

And recorders are introduced in new line of process instruments.

A new line of process instruments includes potentiometric and a.c. bridge recorders and recording controllers. Designed for continuous measurement and control uninterrupted by periodic standardization they incorporate new measurement circuitry and components. Foremost features are a magnetic standard in the potentiometric system and a bridge-balancing unit in the a.c. bridge system.

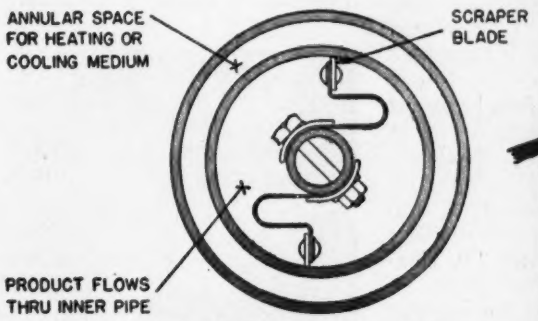
Both models are available with either electric or pneumatic control. A unique centerless pointer simplifies chart changing and leaves most of the chart exposed for easy reading.

The new line is expected to reduce maintenance and component replacement costs considerably. The magnetic standard eliminates dry cells, slidewires and many moving parts found in conventional potentiometric instruments.

Other advantages include plug-in

Time to Change...

...FROM BATCH TO CONTINUOUS PROCESS



Section thru Double Pipe Exchanger

Scraped Surface Exchanger Unit under test in our shop

Unsurpassed for Top Performance in Processing characterized by:

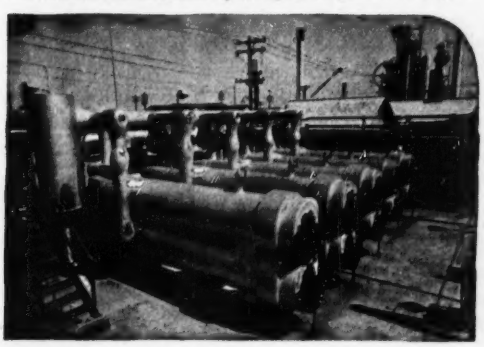
1. Heat transfer with crystallization
2. Heat transfer with severe fouling of surfaces
3. Heat transfer with solvent extraction
4. Heat transfer with continuous mixing and conveying
5. Heat transfer with high viscosity

Chemical processors in search of equipment with which to modernize operations are invited to consider the possibilities of Vogt *flow-thru* Scraped Surface Exchangers in such service. The wide range of uses to which they have been adapted indicates their definite value in the chemical processing fields.

Vogt Scraped Surface Exchangers are closed, *flow-thru,* pressure type systems which permit the use of flammable, volatile and expensive solvents with greatest safety and no danger of solvent loss. Usually fabricated from ferrous material, their simple construction permits the ready use of special materials such as pure nickel or stainless steel to meet special requirements.

General information is in Bulletin PE-1, write for it.

An outdoor installation of Scraped Surface Exchangers



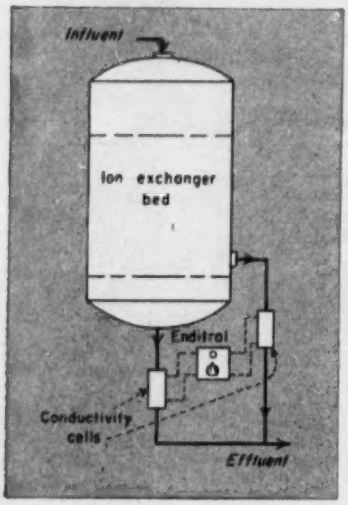
Vogt flow-thru

Scraped Surface EXCHANGERS

HENRY VOGT MACHINE CO.
LOUISVILLE, KY.

BRANCH OFFICES:
New York, Philadelphia, Chicago, Cleveland St. Louis, Dallas, Charleston, W. Va.

components, anti-backlash gearing, internal illumination and an integral pen-inkwell assembly that realigns automatically.—**General Electric Co., Schenectady 5, N. Y.** **280D**



Ion Exchanger Control

For hydrogen cation exchanger indicates end of operating run.

Suitable for use with either a hydrogen cation exchanger or a highly basic anion exchanger the Enditrol device determines the end of the operating run. Also, it can automatically initiate regeneration of the exchanger. It eliminates the dangers of over-running and the chemical and water wastages caused by under-running.

When operated downflow, a columnar-bed ion exchanger becomes exhausted from the top downward with the bottom being the last portion exhausted. Normally effluent from the column contains free acidity in the form of carbon dioxide, hydrochloric acid and sulfuric acid.

For most uses the operating run is terminated when the free mineral acidity falls to 90% of the value prevailing during most of the run. At this point the bicarbonates, chlorides and sulfates present in the raw water are for the most part passing on through the unit because the resin is exhausted.

The Enditrol operates by comparing the acidity of the effluent with a sample of water taken from a tap 4 to 8 in. above the bottom of the bed. This is done by passing ing the two samples through a conductivity cell and comparing them.

Normally conductivity of samples from the two points will have a ratio of approximately 1.0. However, when the exhaustion line in the bed has passed the sampling tap the conductivity ratio will jump, in favor of the effluent, into the range of 1.2 to as much as 3.0. In other words the effluent still contains the normal amount of free acidity. However, slightly above the discharge point the bed is exhausted and here with metallic ions of sodium, calcium and magnesium predominating in the water the conductivity falls off.

One prime advantage: since the Enditrol operates on conductivity ratios it is not affected by changes in raw water.—**The Permutit Co., 330 West 42nd St., New York 36, N. Y.** **282A**

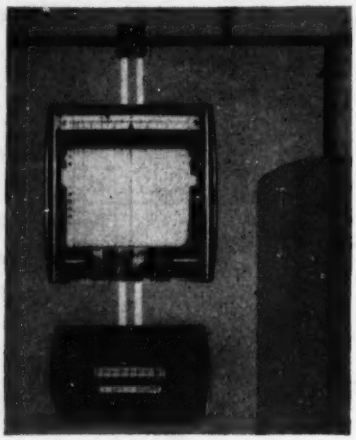
Density Meter

Indicates, records and controls density automatically and continuously.

The density of material flowing through a pipeline can be measured continuously with the nuclear-electronic Densi-O-Meter. It operates on the null-balance principle to give density readings to the third decimal place.

Measurement depends upon the absorption of gamma rays by the material under observation. As the density increases, so does the absorption. This is balanced off against the absorption of rays from the same or identical source by a reference material.

The Densi-O-Meter has three main parts: a measuring unit that is bolted right into the line in sizes from 2 to 8 in.; an amplifier and a recorder, which are similar to those in a standard pH measuring circuit.—**Sierra Industrial Instrument Co., 371 Fourth St., San Francisco 7, Calif.** **282B**



Receiver-Integrator

For graphic panels totalizes process flow on counter.

An accurate and continuous total of any process flow is furnished by the Type 224 receiver. This pneumatic-electric instrument was developed for graphic panels.

Integrator consists of two small, self-contained units: a remote counter and a flow receiver. The counter can totalize to 8 digits and can be mounted on the front of the panel. The flow receiver housed behind the panel has a receiver bellows and a cam-switch assembly.

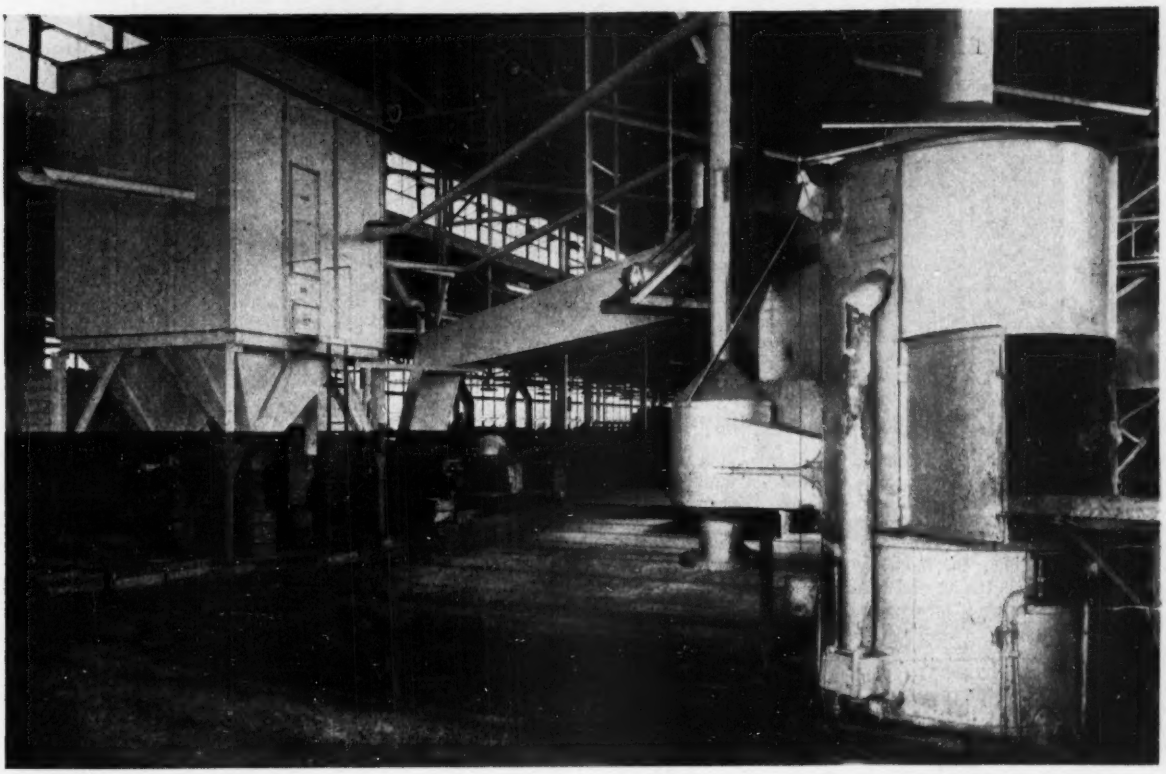
In operation, pneumatic signals (3-15 psi.) from a flow transmitter at the process are received by the bellows which then positions the cam-switch mechanism. An electric impulse from the switch actuates the counter in precise and constant relation to the flow measurement.

Integrators are available for uniform or square root scales to totalize minute, hourly or daily rates.—**The Foxboro Co., Foxboro, Mass.** **282C**

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

pioneering developments keep **DUSTUBE®** *first in dust control*



removing the charge from storage battery dust

Dustube® controls lead dust at its source

Lead oxide dust and fume have ceased to be problems for the Willard Storage Battery Company. Battery manufacturing operations in four of its plants are ventilated by high-efficiency Dustube Collectors. Troublesome dust is completely trapped at its source to keep the working areas clean and dustfree. They have eliminated pollution of the air with the lead oxide dust and fume created by plate cutting machines, dross hoods over refining kettles and scrap conveyors used in manufacturing storage batteries.

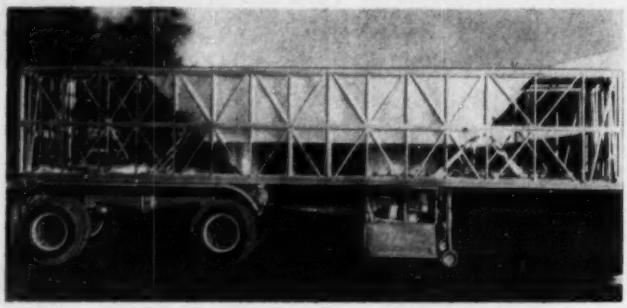
As in plants that set the pace in every industry, the Dustube Collectors were selected by Willard engineers for their many cost-savings features and their high collecting efficiency. "The control of lead dust at its source is of prime importance in our plant," writes Mr. R. J. Halsall, Works Manager of the Memphis plant, "and in planning for its effective control, Willard engineers with years of experienece in this field, specified our present equipment to handle the job."

You, too, can depend on a Dustube installation for dust control that is a more efficient, less costly, and better engineered to your specific requirements.

Catalog 372 explains the reasons why Dustube Collectors control dust more efficiently at lower cost. Send for your copy today.

American
WHEELABRATOR & EQUIPMENT CORP.
347 S. Byrkit St., Mishawaka Ind.

dustube
COLLECTORS



Screw Discharge for Aluminum Semi-Trailer

Now being produced to customer order this aluminum, screw-type-bottom hopper, semi-trailer has some interesting new design features. The container proper is aluminum; the frameless members are high tensile steel tubing. Screw discharger is powered by gasoline motor, operates on an incline toward the rear permitting a discharge height of approximately 44 in. Motor controls are located on either side of trailer. Capacity of the standard unit is 645 cu. ft.—Gramm Trailer Corp., First Lima Bldg., Lima, Ohio. 284A

Feeder

Discharges dry or moist solids from overhead bin.

Operating under an overhead bin a new reciprocating conveyor feeds a constant volume of any dry or moist material. Lumps or variations in the consistency of the material do not effect the operation of the unit.

The conveyor runs on plant air. Electric power is used only to operate a solenoid air valve. Units of various capacities are available and each conveyor is easily adjustable from maximum capacity to zero.—**Hydro-Blast Corp., 2550 North Western Ave., Chicago 47, Ill.** 284B

Bin Discharger

For non-free-flowing bulk materials.

Controlled removal of non-free-flowing materials from deep storage bins is the function of the Exbinner. It makes active a greater portion of the bin bottom to eliminate bridging and segregation.

Flow of materials to conveyor or scales is smooth and continuous, under complete control of the operator. Solids can be removed at a predetermined rate for delivery at a rate exactly equal to the capacity of the conveyor. Also it can be used as a scale feeder.

The Exbinner has all-metal construction and is built in three sizes, with openings to bin of 12 x 48, 24 x 48 and 67½ x 48 in.—**Superior Grain Separator Co., 1212 Washington Ave. So., Hopkins, Minn.** 284C

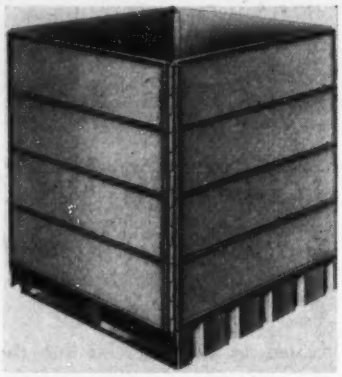
Plastic Trailer

Passes field tests, goes into mass production.

A trailer with a completely plastic body has successfully passed tests in the field and now is in quantity production. The plastic freighter is corrosion resistant and non-electrolytic. It can transport hides, lye, storage batteries and other types of corrosive materials without need for special precautions.

Still another advantage is the ease with which the fiber glass and polyester resin plastic can be cleaned. It washes as easily as a pane of glass and is impervious to smells.

The plastic material is a little lighter than aluminum, has approximately the same strength and is impact resistant. In case of damaged panels repairs can be made quickly without need for special tools or equipment.—**Strick Co., Whitaker Ave. at Godfrey, Philadelphia, Pa.** 284D

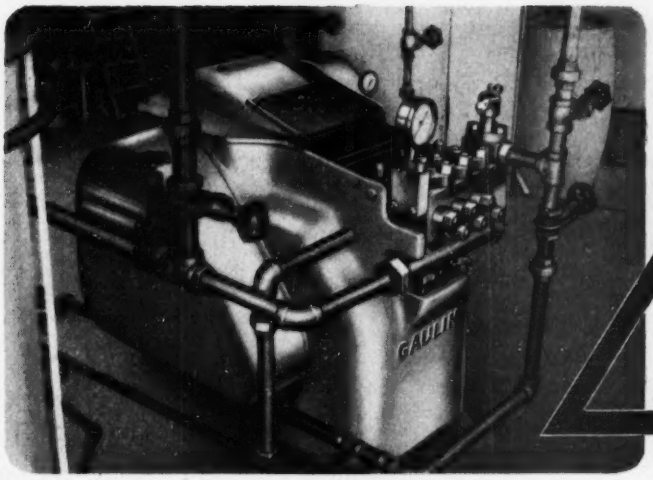


Collapsible Steel Box

Can be used over and over, withstands abuse.

Recently announced as now available is the light weight, collapsible Collaps-a-tainer steel shipping box. Featuring hinged construction the box can be assembled by one man in a fraction of a minute. To knock down just pull two hinge pins and fold sides.

Constructed of 18 gage steel with 16 gage reinforcements the box weighs approximately 100 lb. Interior cubic space measures 30 in. on a side. Fully collapsed the unit measures 31½x31½x9 in.—**Republic Steel Corp., Pressed Steel Div., 3100 East 45th St., Cleveland 27, Ohio.** 284E



Available in any capacity from 25 to 4000 gallons per hour — with operating pressures up to 8000 PSI.

4 WAYS a GAULIN HOMOGENIZER

makes better Emulsions and Dispersions

MAKES THEM UNIFORMLY FINER

A Gaulin Homogenizer forces products under high pressure through a homogenizer valve assembly, where it passes at tremendous speed through a microscopic orifice — shears, shatters and explodes them down to their ultimate particle size.

DISPERSES THEM EVENLY

A Gaulin instantly disperses all ingredients into a completely uniform emulsion or dispersion.

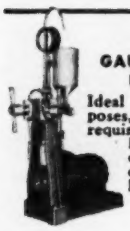
PREVENTS SEPARATION

Because a Gaulin produces a finer, more uniform dispersion, it stops separation in most emulsions completely . . . greatly retards it in others.

SAVES PROCESSING TIME AND MONEY

The continuous, high speed operation of a Gaulin is a faster, *more efficient* way to make stable emulsions and dispersions. Experience proves a Gaulin *processes more gallons per operating dollar* than any other machine.

Discover what a Gaulin can do for your product. Our complete testing facilities and experience in practically every field will give you the answer — without charge or obligation. Send for a sample today. And write for our Bulletin for further information.



GAULIN PILOT PLANT HOMOGENIZER
Ideal for experimental purposes, operation or process requiring up to 25 gallons per hour capacity. Handles quantities as small as one pint. Available on low rental basis.

GAULIN TWO-STAGE COLLOID MILL
Stator is jacketed for cooling or heating. Gap setting adjustable for .001" to .045". Only 45 seconds clean-up required in changing colors. 12" head room. 12" x 17" floor area.

Gaulin

Manton-Gaulin
MANUFACTURING COMPANY, INC.
71 GARDEN STREET, EVERETT 49, MASS.
World's largest manufacturer of Homogenizers, Triplex Stainless-Steel High Pressure Pumps, and Colloid Mills

GUIDED TOUR CONTINUED

PICTURED FLOWSHEET

Current hydrogen peroxide **304**

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Paper strides boldly toward new record **311**

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Names that made news last month **318**

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TECHNICAL LITERATURE

New literature from the manufacture **404**

How Becco makes peroxide.

Oxidation of ammonium bisulfate to persulfate, then hydrolysis to hydrogen peroxide: These are key processes in Becco's new plant at Vancouver. (p. 304)

Paper aims for new records.

Output of the paper industry has doubled since 1929, with another two-fold increase expected by 1975. That spells a big and lush market for chemicals. (p. 311)

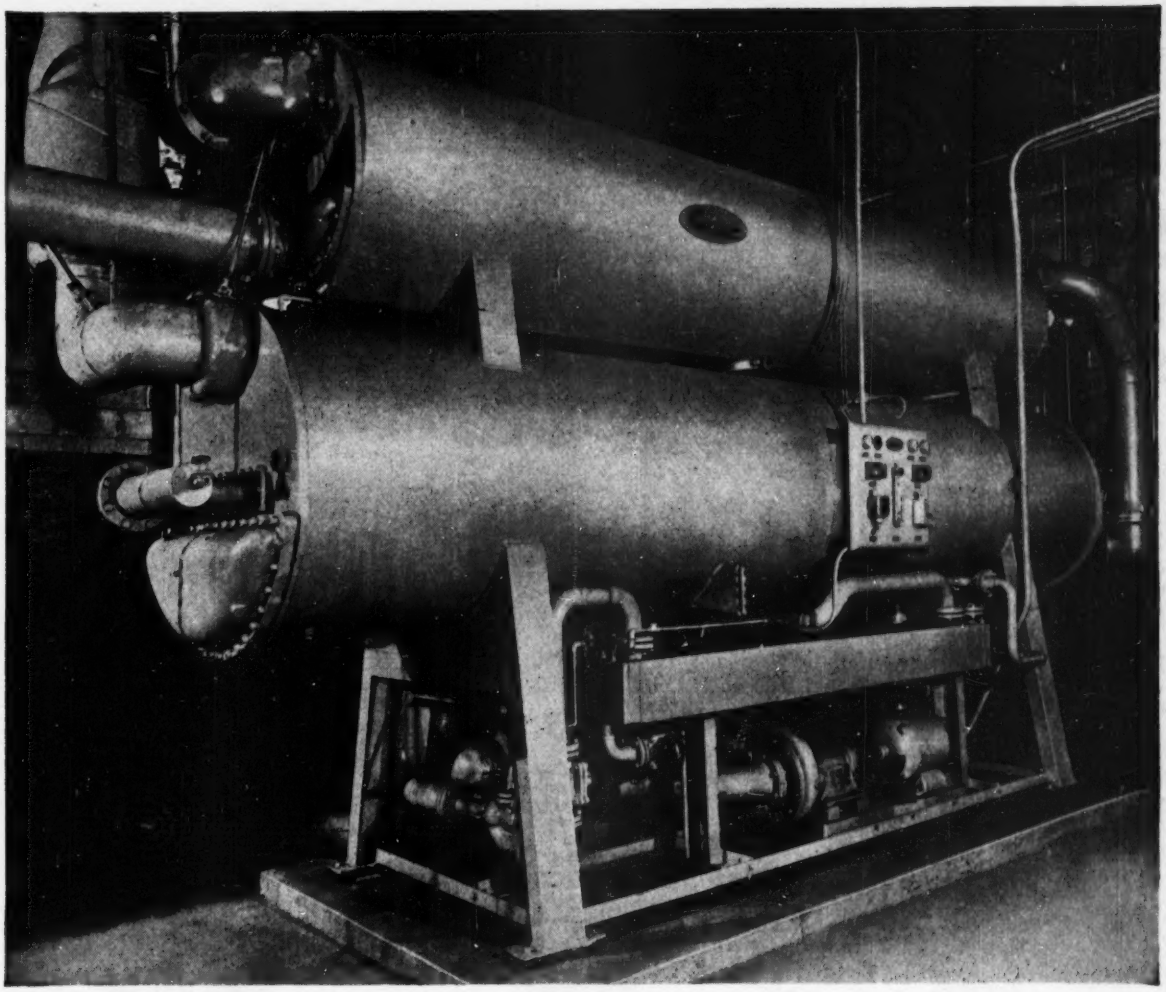
John Olin, Tom Nichols . . .

These are the two top men behind Olin Mathieson, the chemical industry's newest giant and fourth biggest firm. Both men are chemical engineers. (p. 322)

New technical literature . . .

You can now get—free and fast—literature on any subject in your field. Use our new and enlarged section to keep your technical files up-to-date. (p. 404)

Join READER SERVICE on page 393

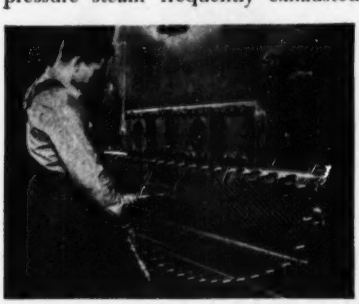


This 350-ton Carrier Absorption Machine is installed at the Joseph Horne Co. Suburban Store in Brentwood Borough, Pennsylvania.

Carrier Absorption Refrigerating Machine uses heat to cut cooling costs

—and AnacondA Cupro Nickel Tubes are again called on for economical quality performance in industry

Until recently, plant and building engineers have been hung on the horns of a cooling dilemma; how to use low pressure steam—frequently exhausted as waste—for chilling water for air conditioning and process cooling. No economical way seemed to exist to harness this heat as a work horse for cooling.



Rolling-in ANACONDA Cupro Nickel Tubes in absorber for new Carrier Absorption Machine.

Carrier Corporation, leading manufacturer of air conditioning and refrigerating equipment, found the solution in *absorption refrigeration.* In 1942, they installed the first pilot plant at the Carrier laboratory using water as a refrigerant and lithium bromide as the absorbent. Since then, a growing number of these large capacity units have been put into operation. They have few moving parts, are practically vibration-free, weigh less per rated ton, and adjust automatically to load.

Carrier selected ANACONDA Cupro Nickel Tubes for use in these machines because of their excellent service record for trouble-free performance under all operating conditions.

What are your condenser and heat exchanger problems? In selecting the proper tube alloy, the experience of our Technical Department is freely available to you. Use it as a short cut to the right solution. Write to *The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.*

54108

FOR EFFICIENT HEAT TRANSFER

ANACONDA®

HEAT EXCHANGER TUBES

Increase Your Output up to 300%...

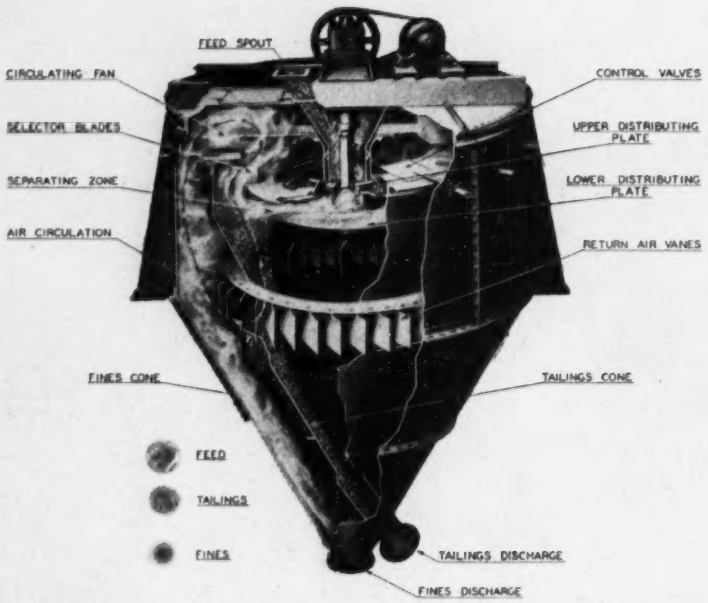
Get Accurate Fines with...

STURTEVANT

Whirlwind Centrifugal SEPARATORS

The Sturtevant Air Separator is one investment that pays off daily profits by increasing production and reducing costs. Its extremely efficient operation assures finer separation of fine material from coarse material with the result that uniform quality of product is always obtained.

They'll not only increase your output by as much as 300%, but provide 10 to 50% savings in power costs, too. They are available in sizes 3 to 16 feet in diameter with capacities from ¼ to 50 tons per hour with a fine-product range of 40 to 325 mesh or finer. Bulletin 087 gives the entire story. Write for your copy.

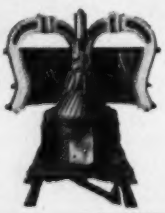


Other Sturtevant Equipment for Increasing Production and Cutting Costs

MICRONIZER® GRINDING MACHINE

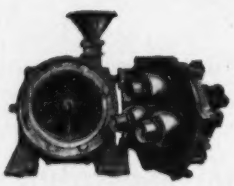
A fluid jet grinding machine, the Sturtevant Micronizer speeds reduction of materials to low micron sizes. These jet mills are especially applicable in fields where a particle size in microns is desired.

Sturtevant Micronizer grinding machines are available in many sizes and capacities.



ROTARY FINE CRUSHERS

for intermediate and fine reduction (1" to ¼"). Open door accessibility. Soft or moderately hard materials. Efficient granulators. Excellent preliminary Crushers preceding Pulverizers.

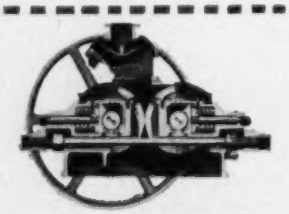


RING-ROLL MILLS

for medium and fine reduction (10 to 200 mesh), hard or soft materials. Very durable, small power. Operate in closed circuit with Screen or Air Separator. Open door accessibility. Many sizes. No scrapers, plows, pushers, or shields.

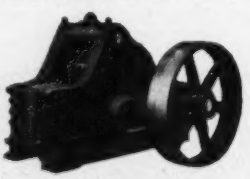
SWING-SLEDGE MILLS

for coarse and medium reduction (1" to 20 mesh). Open door accessibility. Soft, moderately hard, tough or fibrous substances. Built in several types and many sizes.



CRUSHING ROLLS

for granulation, coarse or fine, hard or soft materials. Automatic adjustments. Crushing shocks balanced. For dry or wet reduction. Sizes 8x5 to 38x20. The standard for abrasives.



JAW CRUSHERS

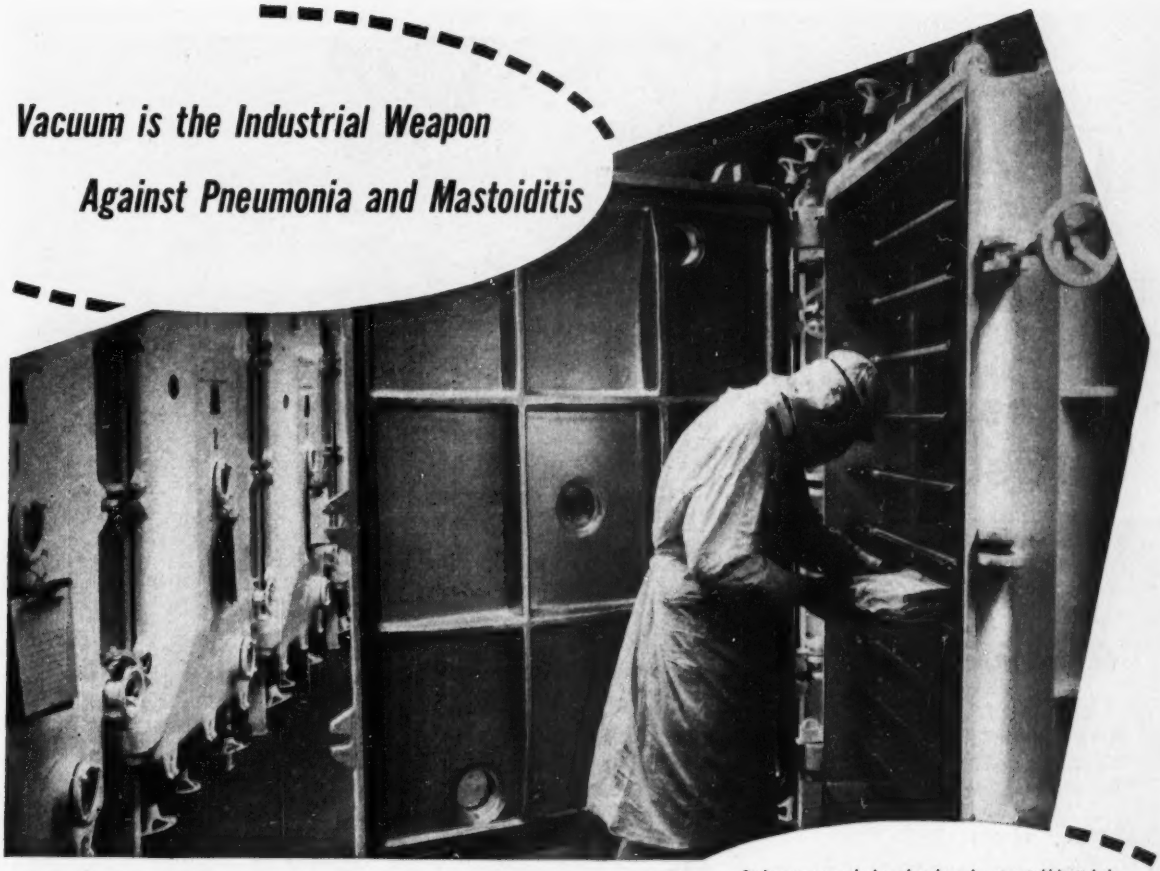
for coarse, intermediate and fine reduction of hard or soft substances. Heavy or light duty. Cam and Roller action. Special crushers for Ferro-alloys. Several types, many sizes.

STURTEVANT MILL COMPANY

100 CLAYTON STREET, BOSTON 22, MASSACHUSETTS

DESIGNERS & MANUFACTURERS OF CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS • MECHANICAL DENS AND EXCAVATORS • ELEVATORS • MIXERS

Vacuum is the Industrial Weapon Against Pneumonia and Mastoiditis



Stokes vacuum drying chambers in use at Abbott Laboratories, North Chicago, Ill., for the drying of crystalline penicillin and other antibiotics. Picture is taken through window of sterile drying room. Operator is masked and gloved to maintain sterile conditions.

Remember when these were dreaded afflictions? Now mastoid troubles are a rarity and pneumonia is no longer a dreaded killer, thanks to penicillin. Penicillin, dried in Stokes vacuum chambers at Abbott Laboratories, North Chicago, Ill., is one of many pharmaceuticals which must be dried under vacuum because only under vacuum are the destructive effects of air and heat avoided.

Vacuum drying — in many cases from the frozen state — is also the drying method for blood plasma, mycins, hormones, antibiotics, anti-venoms and biologicals.

For many industrial chemicals, vacuum drying is the efficient, low-cost high production method for removing water and recovering valuable solvents safely.

Stokes experts have 50 years of experience in vacuum processing to share with interested manufacturers. Send for any or all of the following informative brochures:

(1) Freeze-Drying in Industry,
(2) Laboratory Freeze-Drying,
(3) Vacuum Drying.

F. J. STOKES MACHINE COMPANY
PHILADELPHIA 20, PA.

STOKES

STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages / Industrial Tabletting, Powder Metal and Plastics Molding Presses / Pharmaceutical Equipment

Wagner®
TRANSFORMERS
... the choice of leaders in industry

CHOOSE WAGNER UNIT SUBSTATION TRANSFORMERS

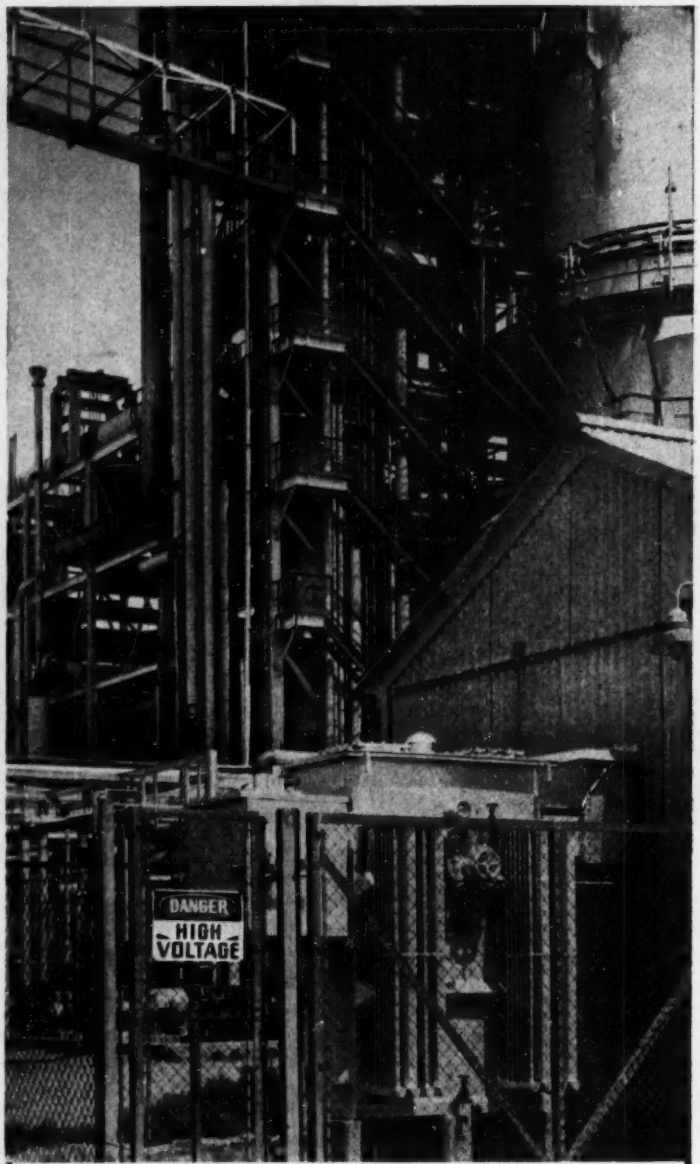
for always dependable power...

Here's dependability at work! This Wagner liquid-filled unit Substation Transformer feeds the catalytic unit at The Carter Oil Company refinery in Billings, Montana.

You'll find hundreds of Wagner Transformers, furnishing *always dependable* power, in spots where failure would incur great cost, because Wagner Transformers are known for their unfailing dependability—a reputation backed by more than sixty years of transformer building experience.

Wagner Unit Substation Transformers, both liquid-filled and dry-type, are carefully designed to meet distribution requirements. Both liquid-filled and dry-type unit substation transformers are built in ratings through 2000 kva, 15 kv and below—you can choose the type and rating that exactly meets your load-center distribution requirements.

Bulletins TU-13 and TU-56 give full information. Your nearby Wagner engineer can help you solve your load-center problems. Call the nearest of our 32 branch offices, or write us.



This 750 kva, 2400/4160Y to 480 volt, 60 cycle, three-phase, liquid-filled Wagner Unit Substation Transformer feeds the catalytic unit at The Carter Oil Company, Billings, Montana refinery. It is throat connected to switchgear in the adjoining building. Purchased and installed by The Fluor Corporation, Ltd., Engineers and Constructors for the Petroleum, Chemical and Power Industries, Los Angeles.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6407 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

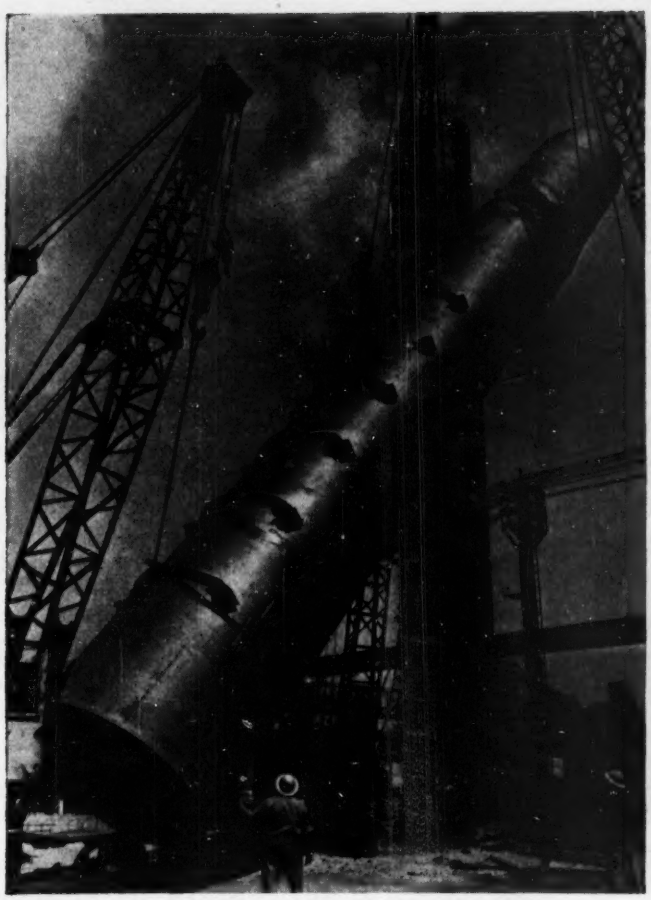
BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

ELECTRIC MOTORS
TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

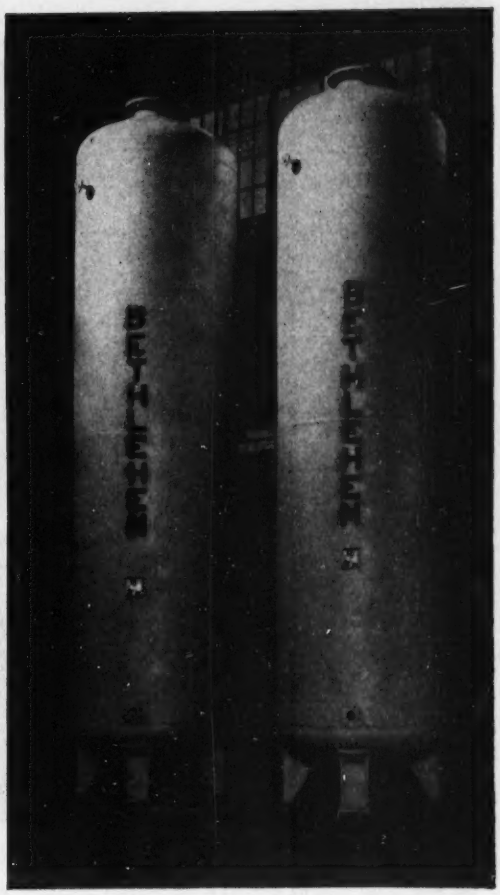
T54-3

15 WHOPPERS—This 60,000-gal propane tank, third in an order for fifteen, is shown on its way from the Bethlehem Weldment Shop to the customer's chemical plant in Kentucky. Dimensions: 118 ft, 8 in. long; 9 ft, 7⅞ in. OD; 15/16 in. shell.

WHAT'S NEW IN WELDED VESSELS



GOING UP!— Crawler cranes triple-team a 33½-ton absorber tower into place. Second such unit at this desulphurization plant, the tower is over 97 ft high and 11 ft OD. Shell thickness: ⅜ in.



BOUND FOR NORWAY--These 21 ft-6-in.-high ammonia storage vessels weigh 11,900 lb each, and measure about 5 ft in diameter.

For further information about welded vessels, towers and other equipment for chemical and petroleum processing, call the nearest Bethlehem sales office.

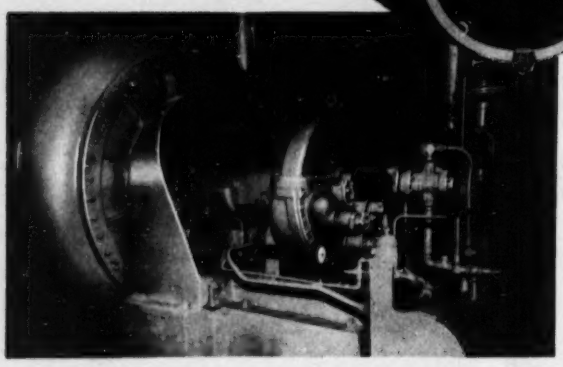
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Accent on rugged simplicity

CASING AND BACKPLATE of cast Meehanite. All surfaces adjacent to the impeller are machined to close tolerance.
ONE-PIECE, OPEN TYPE IMPELLER; develops no end thrust, mounted on tapered shaft and readily removable.
BASE AND HOUSING of heavy fabricated steel, strong and rigid.
INLET CONNECTION AND GUIDE VANES of cast Meehanite.



Typical installation of an Elliott compressor handling 25,000 inlet cfm of air, at a discharge pressure of about 2.5 psig; driven by Elliott 300-hp steam turbine at 3300 rpm.

PA-2

ELLIOTT

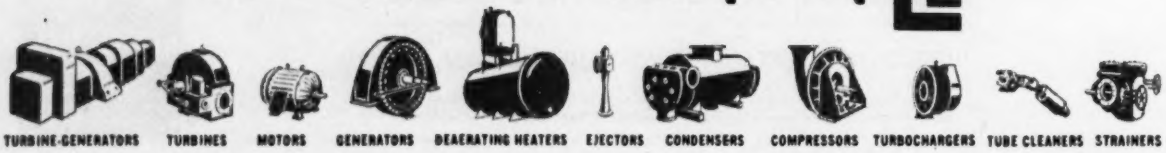
CENTRIFUGAL COMPRESSORS

are extremely simple in design and construction. Hundreds are serving in processes requiring the handling and compression of large quantities of air or gas. All parts in contact with the gas to be handled can be made of suitable materials.

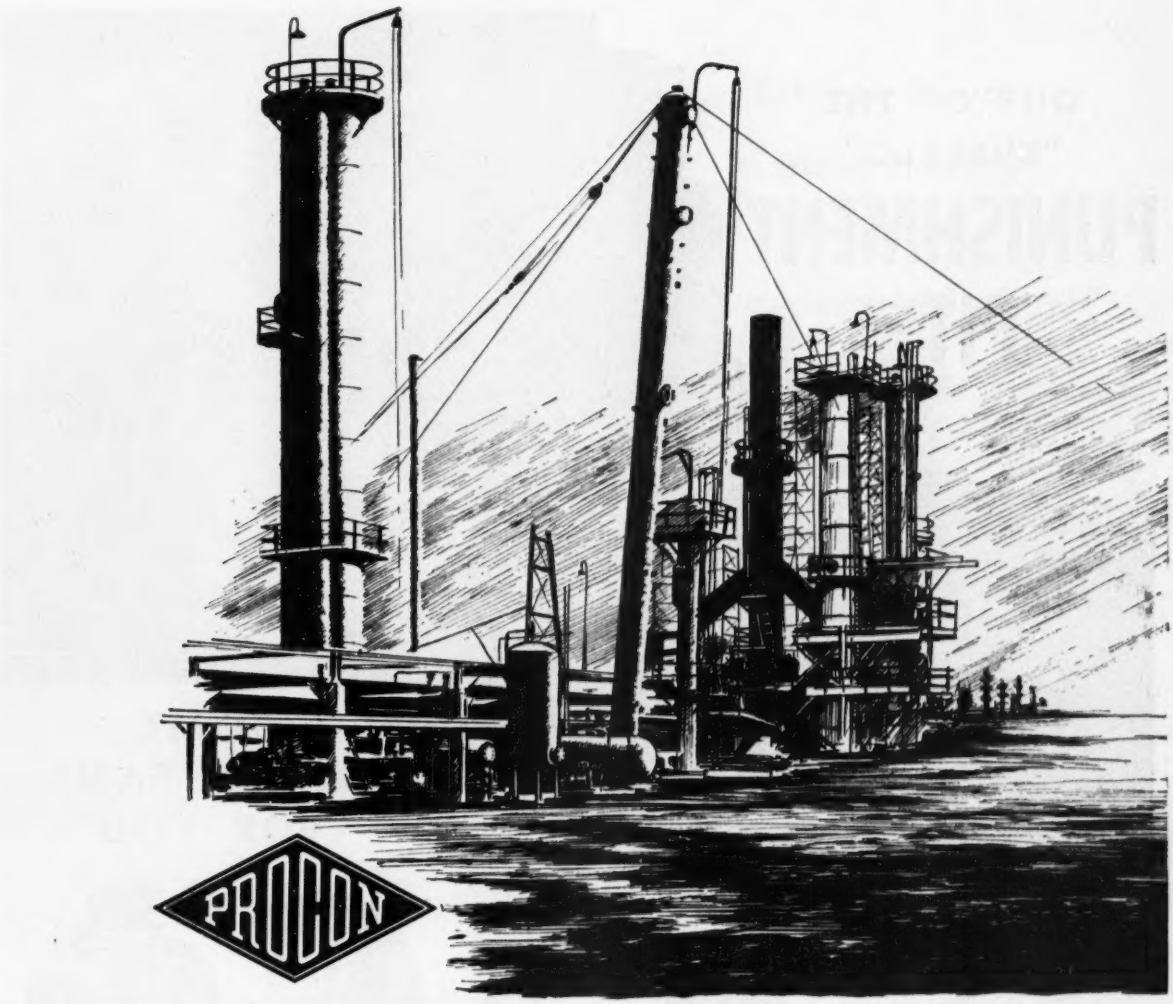
Elliott compressors are made in both single-stage and multistage types, for pressures up to 100 psig, with capacities to 125,000 cfm. Elliott Company also builds the motor or turbine drive, including speed-increasing gears when required.

For details and specifications consult your local Elliott field engineer, or write Elliott Company, Centrifugal Compressor Dept., Jeannette, Pa.

ELLIOTT Company



TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS



an acknowledged leader in Process Construction

Procon has every facility for making drawing board designs and quickly transforming them into all types of chemical, petrochemical, or petroleum processing plants. What's more, Procon's ability to do a job fast, accurately, and thoroughly, results in important economies in time and money.

Petroleum processors the world over are recognizing the value of selecting Procon to handle their process construction, regardless of the size or type of job.

Among the many projects which Procon has completed or is currently working on are a complete chemical plant, a complete petroleum refinery, Udex extraction units, UOP Platformers and Fluid Catalytic Cracking units, crude units, polymerization facilities, vacuum distillation equipment, and gas recovery units. In addition, Procon is ready to handle a wide variety of offsite work including boiler plants, cooling towers, oil separators, loading racks, transfer pumping facilities, and instrument and control buildings.

With such a record, petroleum refiners everywhere know that—If It's Process Construction, It's A Job For Procon.

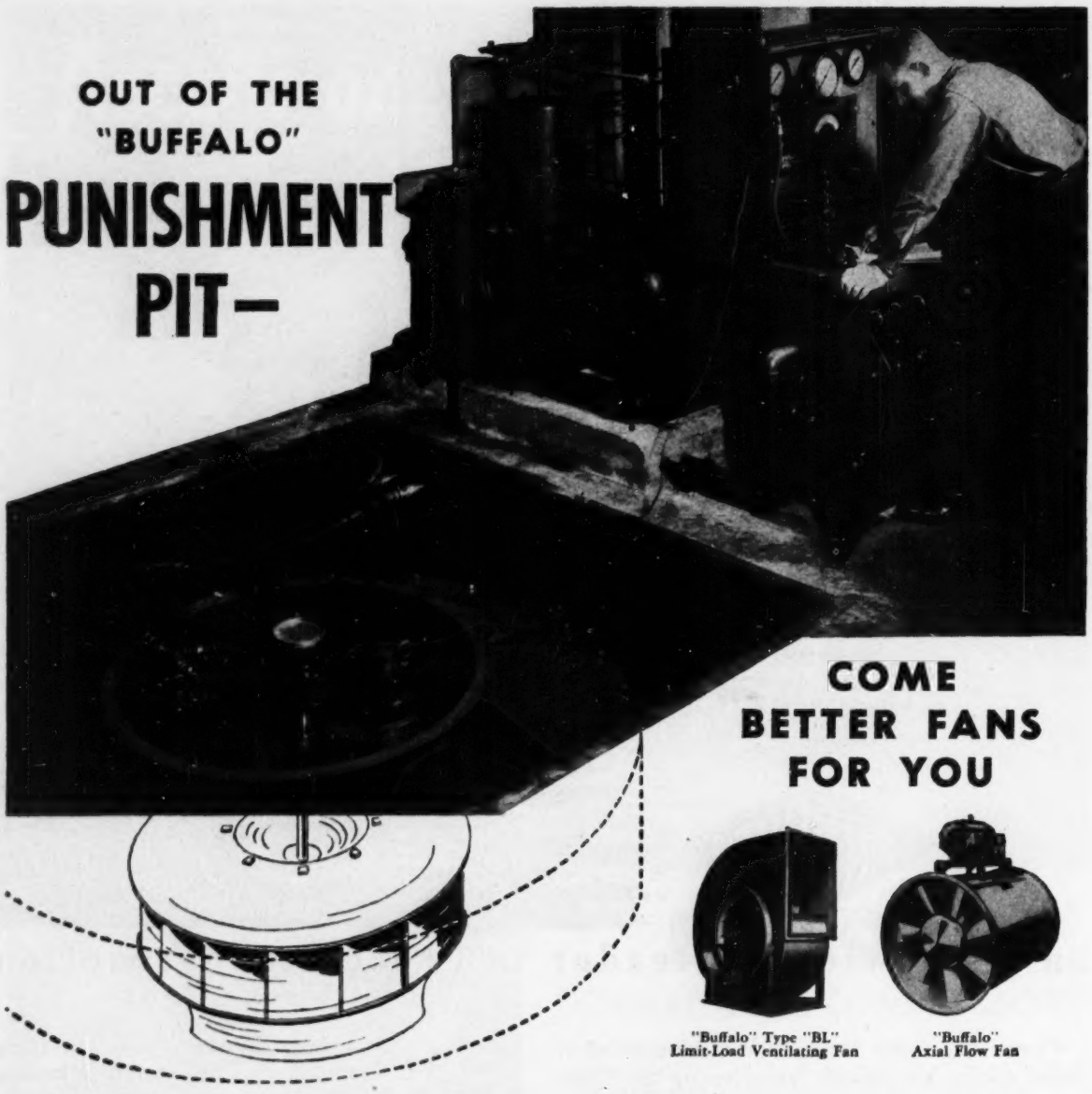
PROCON *Incorporated*

PROCESS CONSTRUCTION

1111 MOUNT PROSPECT RD., DES PLAINES, ILLINOIS, U. S. A.

IN CANADA	PROCON (CANADA) LIMITED 68 YONGE STREET TORONTO 1, ONTARIO
IN ENGLAND	PROCON (GREAT BRITAIN) LIMITED 112 STRAND, LONDON, W. C. 2

OUT OF THE "BUFFALO" PUNISHMENT PIT—



COME BETTER FANS FOR YOU

"Buffalo" Type "BL" Limit-Load Ventilating Fan

"Buffalo" Axial Flow Fan

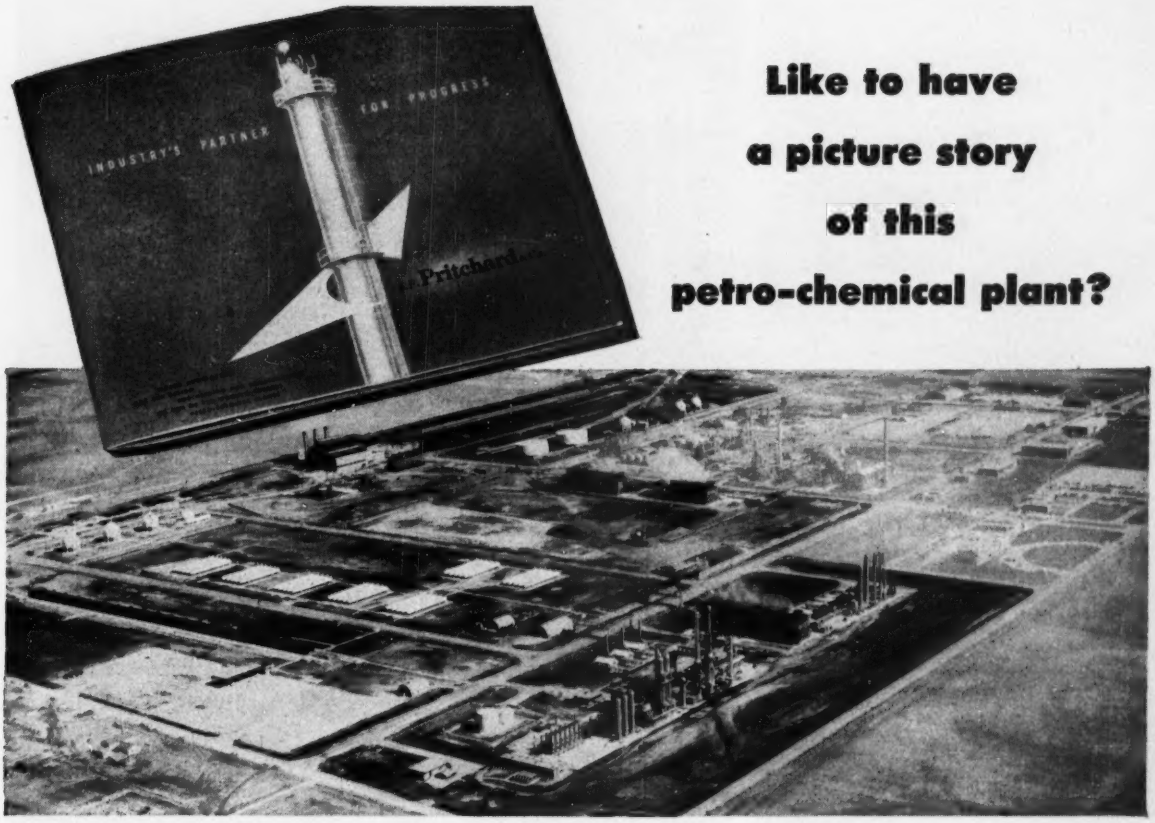
• To be sure that "Buffalo" rotors can stand far greater stress than they would ever encounter in an installation, we deliberately try to destroy them in this "Buffalo" vacuum test pit! Here, in a partial vacuum, the rotor to be tested can be revolved at tip speeds as high as 60,000 and even 70,000 feet per minute. The slightest unbalance, the slightest structural weakness, would result in destruction of the rotor at these fantastic speeds — and it shows up here in the Punishment Pit, not in the installed fan.

This is just one phase of the rigid testing and excellence of engineering, or "Q" Factor*, which assure you of a best buy when you specify "Buffalo" Fans. Why not write for "Buffalo" engineering literature on *your* air handling problem?

**The "Q" Factor — The built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY
501 BROADWAY BUFFALO, NEW YORK
Publishers of "Fan Engineering" Handbook
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

VENTILATING PRESSURE BLOWING AIR CLEANING COOLING AIR TEMPERING HEATING INDUCED DRAFT FORCED DRAFT EXHAUSTING



Like to have a picture story of this petro-chemical plant?

Write for this booklet today!

Here's a brochure that's almost as good as a guided tour through the Tuscola, Illinois plant of National Petro-Chemicals Corporation. It's a picture story, in brochure form, of the design, construction and engineering of one of the world's largest petro-chemical plants.

Twenty-four pages of photographs let you see for yourself the complexity of this $50,000,000 installation, for which J. F. Pritchard & Co. was the major contractor.

Your complimentary copy is waiting. Fill out and mail coupon today. No obligation.

FILL OUT COUPON NOW FOR YOUR COPY!

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210 West 10th Street, Kansas City 5, Mo.

Please send me my complimentary copy of your brochure describing the National Petro-Chemicals Corporation's Tuscola, Ill. plant.

Name _____

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Address _____

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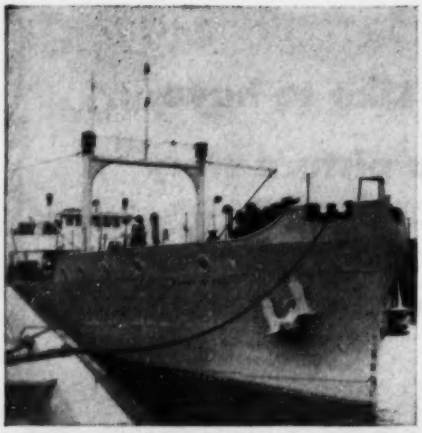
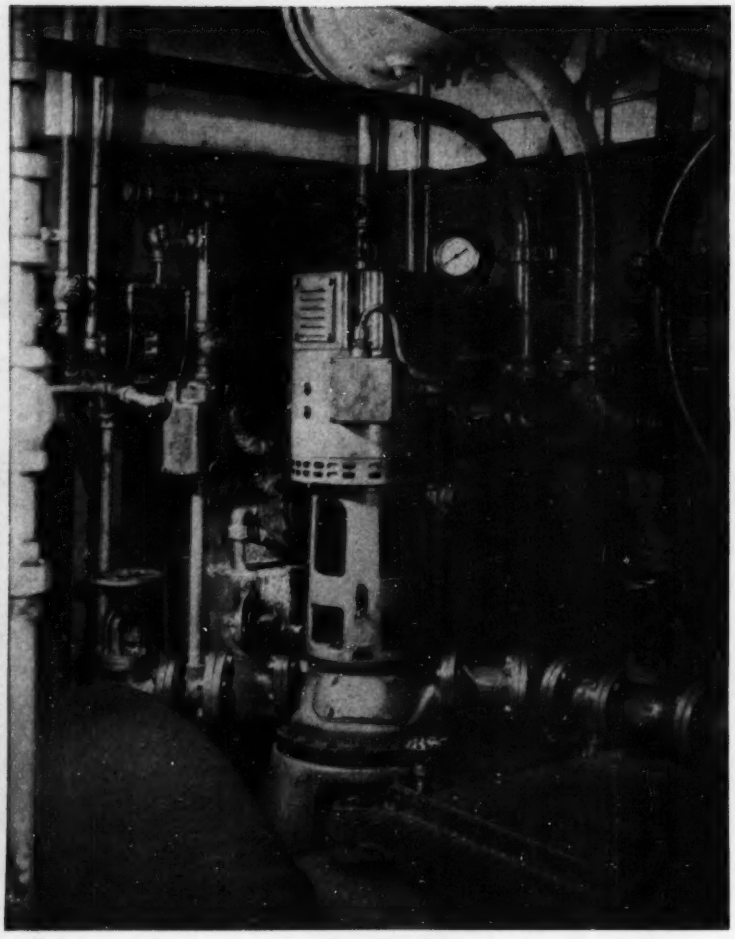


Unique Problem– Common Solution



Although this LaBour pump (and another just like it) aren't at work in the chemical industry, their unusual application is of interest because it proves what we've been saying all along. Competent engineers naturally turn to LaBour.

The two LaBour pumps are installed on opposite sides of the motorship *Wards Island*, a sludge disposal vessel owned by the New York City Department of Public Works. The pumps circulate sea water for cooling the diesel engines. Either pump may lose prime as the vessel rolls, but must pick up immediately as the roll reverses so it will be supplying water when the other pump loses prime.

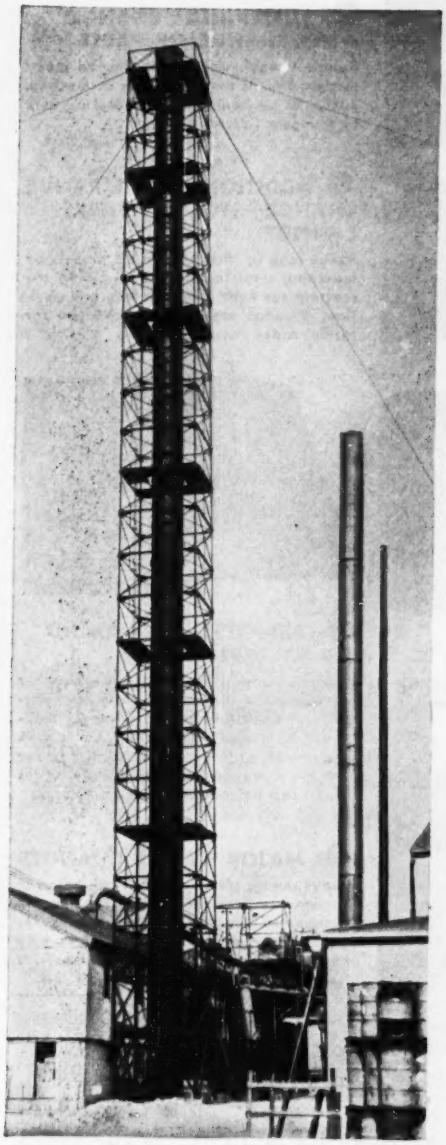
Failure of the system to operate as planned could result in costly damage to the engines. So the marine engineers responsible, like their brothers in the chemical industry, specified the pumps known for dependability—LaBour. The LaBour Type BG pumps prime quickly as called upon, and everybody's happy.

It's a fact that no engineer, marine or chemical, has ever had cause to regret that he specified LaBour. That's why so many top men seldom specify anything else.

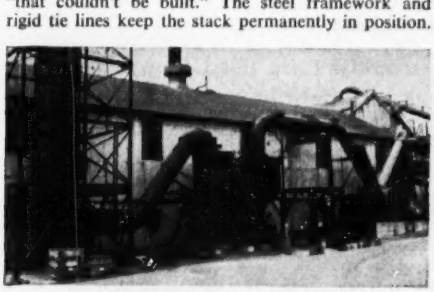
ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LABOUR

THE LABOUR COMPANY, INC. ★ Elkhart, Indiana, U.S.A.



IN THE AIR, towering 200′ high is a Haveg stack "that couldn't be built." The steel framework and rigid tie lines keep the stack permanently in position.



ON THE GROUND, more Haveg fume duct, scrubbers, precipitators, fans, valves control corrosion.

THE TALL HAVEG STACK at the Washington, Pa. plant of the Molybdenum Corp. of America increased the efficiency of the corrosive fume removal system and helped management cut costs. It was made possible by the correct use of supports, planned by the refiner's engineering staff.

Huge corrosion-proof stack of HAVEG pays for itself in one year at plant of Molybdenum Corporation of America!

The Molybdenum Corporation of America had a costly corrosion problem and they solved it themselves, with the erection of the world's tallest stack of Haveg. It is 200′ high with a 5′ diameter and is a major part of the fume removal system at the molybdenum and tungsten refiner's Washington, Pa. plant. Haveg replaced an alloy stack with a service life of less than one year, and has already paid for itself.

It took engineering skill and imagination by Molybdenum Corporation officials to plan such a king-sized use of a plastic material. For years Haveg had helped them fight corrosion in the plant, but could it be built into a stack tall enough to do the job?

Sure, Haveg can be big. It has adequate physical strength for self-supporting equipment. Sections can be built up, with standard metal flanged connections. But how could sway be controlled? Did Haveg lend itself to this type of construction?

The answer is in the photos. By spacing the supporting steel framework far enough out from the Haveg sections, a stack was built so free of sway that a transit could not detect any.

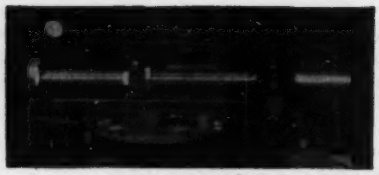
Also, the outstanding corrosion resistance of Haveg gave the refiner a stack that has every evidence of lasting for years, without repairs, without the previous costly yearly replacement.

This is a good example of what can be done with Haveg, a plastic material sold in finished form, as stack sections, towers, tanks, piping, valves, etc. Find out all the ways Haveg can help you fight corrosion. Call the sales engineer listed. Write for the big 64-page illustrated Bulletin F-6 with size and chemical resistance charts, design specifications.

ATLANTA, Exchange 3821 • CHICAGO 11, Delaware 7-6088
CINCINNATI 36, Sycamore 2600 • CLEVELAND 20, Washington 1-8700
DETROIT 39 Kenwood 1-1785 • HOUSTON 4, Jackson 6840
LOS ANGELES 14, Mutual 1105 • SEATTLE 7, Hemlock 1351
ST. LOUIS 17, Mission 5-1223 • WESTFIELD, N. J., Westfield 2-7383

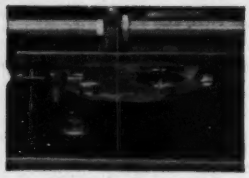
HAVEG CORPORATION
NEWARK 2, DELAWARE
TRADE MARK REG. U. S. PAT. OFF.
FACTORY: MARSHALLTON, DEL. • Wilmington 3-8884
A SUBSIDIARY OF CONTINENTAL-DIAMOND FIBRE CO.

PROCESS CHANGES CAN'T OBSOLETE THIS TRANSMITTER . . .



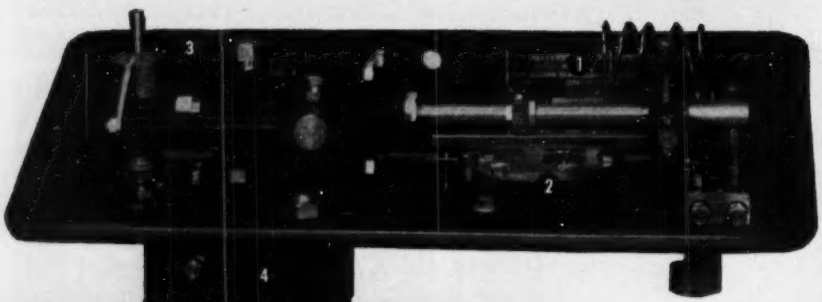
❶ 10-1 RANGE CHANGE —NO CHANGE OF PARTS

Double weighbeam construction on many models permits range changes as much as 10-1, just by turning a set of locking nuts to change a fulcrum point.

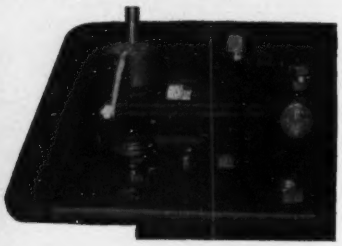


❷ ADDITIONAL 16-1 RANGE CHANGE—STILL NO PARTS CHANGE

Range may be changed on all models by loosening retaining bolts and sliding the reaction chamber to a new leverage position. Reaction area may be changed for further range change.



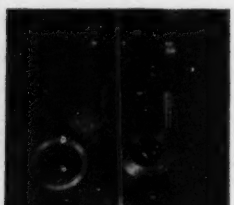
Process Model P-0331 with cover removed



❸ SUPPRESS, COMPOUND OR REVERSE RANGES

Balancing spring, installed to exert either an upward or downward force on transmitter weighbeam, quickly converts transmitter for range suppressions up to 80% of total range, for reversed ranges or for compound ranges where pressure fluctuates above and below atmospheric pressure.

REPUBLIC PNEUMATIC TRANSMITTER with EASY RANGE CHANGE



❹ MAJOR RANGE CHANGES

Range change plates may be easily inserted or removed from measuring chamber to change the effective diaphragm area for major range changes. Similar plates may be used also in the reaction chamber for further range change.

Here's the pneumatic transmitter for measuring differential, flow, pressure or level that saves you time and money when operating conditions are not definitely known or processes are likely to be changed. Extreme flexibility of design lets you adapt the same transmitter chassis for almost any range of measurements—often without any change of parts.

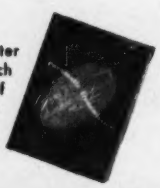
Process Model pictured above has a differential range of 0-12" H_2O minimum and 0-880" H_2O maximum at operating pressures to 1500 psig. Other models are available for differential ranges as low as 0-0.6 H_2O or as high as 0-750 psi.

Transmitters may be constructed of special materials to handle almost all types of corrosive fluids. Ruggedly built, they give long service out-of-doors. Accuracy is guaranteed at ½% of full range on standard models.

Republic transmitters are used in process, chemical and petroleum plants all over the country. Investigate their advantages for your plant.

FREE DATA BOOK

Get the full story about Republic transmitter flexibility. Send for free Data Book which gives all the facts about complete line of Republic transmitters, including Square Root Extracting and Pneumatic Electric models.



REPUBLIC FLOW METERS CO.

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NOW CHASE® SELLS STAINLESS STEEL, TOO

Bars, sheets, wire, pipe and tubing now available through your Chase warehouse or sales office.

So many Chase customers use stainless steel in addition to brass and copper that we have added this metal to our regular line.

Now you can get the same top-notch Chase Service on Stainless Steel that you've been used to on other Chase products. Of course, regular delivery and cutting facilities are available on Stainless Steel orders, too.

Make Chase Your Headquarters for Stainless Steel, Too

All 24 Chase warehouses plus the Chase sales offices and Chase mills are ready to help you get prompt delivery. If your Stainless Steel order can't be filled from local stock, you'll get prompt shipment from another of the Chase warehouses or from the mill.

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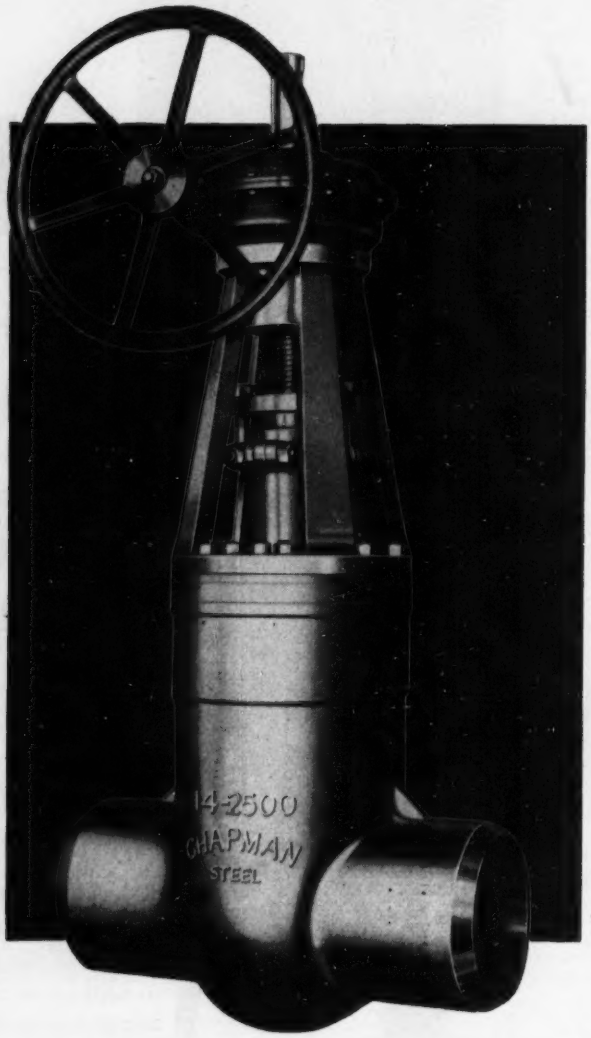
The Nation's Headquarters for Brass & Copper

Albany† Atlanta Baltimore Boston Chicago Cincinnati Cleveland Dallas Denver† Detroit Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester† St. Louis San Francisco Seattle Waterbury (†sales office only)



Special Qualities at Standard Prices

...in CHAPMAN Steel Valves

When you buy Chapman Steel Valves, you buy dependable operation and low maintenance cost — you can select steels to meet your specifications from over a dozen alloys made in Chapman's own steel foundry, under rigid scientific supervision.

When your valves are Chapman, you're sure they seat tightly and accurately, without jamming, chattering or wearing excessively. Close tolerances mean long service and little maintenance.

The Chapman Steel Valve line, — gates, globes, and checks, is complete for pressures of 150, 300, 400, 600, 900, 1500 and 2500 pounds and temperatures to 1000°F; all types of gates and globes excepting the 150 lb. class are available with 3 types of bonnet joints — welded, pressure seal, or bolted. Each has its own particular application depending on the medium to be handled.

Chapman's long experience and mass production mean economies. Quality is unsurpassed. So it pays to see Chapman first for every steel valve requirement . . . standard or special, gate, globe, angle or check. Chapman Steel Valves equal or exceed A.S.A. standards in every range. Write now for Catalog No. 20.

The CHAPMAN Valve Manufacturing Co.

INDIAN ORCHARD, MASSACHUSETTS

UNICHROME
Trade Mark

News about
COATINGS for METALS
Metallic . . . . . Organic . . . . . Decorative . . . . . Protective

New achievements in linings for drums

Latest advances in protective coatings engineered into Unichrome Drum Linings— improve further on already dependable materials

Modern approach to maintenance-painting halts corrosion

It's well established by this time that effective maintenance painting for corrosive areas requires a three-step approach. (1) Adequate surface preparation. (2) Use of the correct coating system. (3) Proper application of the coatings (an ample number of coats).

"Step 1" insures good adhesion and resistance to underfilm corrosion. "Step 3" makes for needed film thickness and continuity. These are clear-cut steps for the maintenance department.

"Step 2", however, requires the engineer to keep up with all advances in coatings. To chemical and corrosion engineers, United Chromium offers its technical help in matching the right coating systems to the required service. Sixteen specialized Ucilon* Protective Coating Systems now available cover requirements of hundreds of strong corrosives.

Specific details in Bulletin MC-8.

**Trade Mark*

Durable film thickness easily obtained with plastisol coatings

Plastisol coatings offer a valuable "tool" for corrosion control. First of all, they fill in and level surface pits rather than bridging them. Secondly, they build up controlled thickness from 3 mils anywhere up to 3/16-inch with a single application, thereby assuring film continuity even over projections and edges.

For any piece of equipment or surface that can be uniformly baked, therefore, Unichrome Plastisol Compounds offer one of the easiest, most economical ways to apply long lasting vinyl coating protection. Send for Bulletin VP-1.

UNITED CHROMIUM, INCORPORATED

100 East 42nd Street, New York 17, N. Y.
Detroit 20, Mich. • Waterbury 20, Conn.
Chicago 4, Ill • Los Angeles 13, Calif.
In Canada:
United Chromium Limited, Toronto 1, Ont.

DRUM lining service represents one of the toughest applications for protective coatings. In a drum, coatings are often subjected to prolonged contact with active materials. They have to withstand rough and tumble service without fracturing and losing film continuity.

Thanks to modern coating developments, lining drums need be no problem. Products can be shipped with no danger of drum corrosion and product contamination. Three of the latest type of coatings which fill the requirements of this low cost, desirable type of packaging are included in Unichrome Drum Linings.

FIRST PRACTICAL SPRAYABLE PLASTISOLS

A pioneer in the field of vinyl plastisols, United Chromium has developed practical sprayable materials. This achievement now permits fast, low-cost application of heavy duty vinyl coatings to the interior of drums — in films up to 25 mils thick if desired with just a *single* application.

These Series 4000 Unichrome Drum Linings deliver resilient, seam-free, pore-free protection against such materials as acids, alkalies, salt solutions, alcohols, wetting agents, detergents and others.

EPOXY LININGS ARE TOUGH

Unichrome Series B-179 linings, based on epoxy resins, develop a film that's as tough as a phenolic coating but with greater flexibility.

It therefore withstands considerably more shock and abuse without failure. This series of coatings not only resists strong acids, oils, solvents and food products, but also alkalies — another of its improvements.

THE "WORK HORSE" IN LININGS

Phenolic-based coatings have a long record of dependable performance behind them. Measured against this record, the new phenolic Unichrome Series B-124 Linings prove that even good materials can be improved upon. They are being specified by many leading drum producers and users for their exceptional toughness, durability and economy.

Bulletin DL-2 goes into more detail. Send for your copy.

United Chromium carries on a continuing research program on drum linings, testing various formulations against a wide variety of chemicals and products. Hundreds of tests in test cells such as those shown are being run at all times.

FACTS ON INFRARED FOR THE PROCESS PLANT

Do You Have Process Stream Problems?

Through the use of infrared analyzers a continuous check can be maintained on process stream composition. Thus changes in feed stock, catalyst efficiency, reaction rate or final product composition become readily apparent.

Perkin-Elmer offers the most complete range of infrared instruments for both laboratory and plant use. Complete problem evaluation service is available without obligation. And Perkin-Elmer instruments are supplied sensitized and adjusted for your specific process stream application.

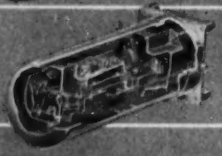
Why not make use of Perkin-Elmer's extensive application engineering facilities? They have been established to provide expert assistance in the application of infrared methods of analysis to specific processes.

Let us show you how your plant operating efficiency may be improved through infrared analysis. Our application engineering facilities are at your service.

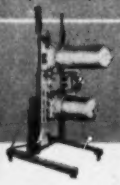
A battery of TRI-NON *Analyzers undergoing sensitization for particular problems in Perkin-Elmer's Application Engineering Laboratory.*

THE ONLY COMPLETE RANGE OF INFRARED INSTRUMENTS TO MEET ALL REQUIREMENTS

FOR THE PILOT PLANT—*Model 14 Multi-Component Analyzer*— Continuously records the concentration of up to six components in a pilot process stream on a six-minute cycle. Ideal for tracking the effects of temperature, pressure, etc., changes in a pilot stream.



FOR THE PROCESS PLANT—*Model 93 BICHROMATOR* Analyzer* —For continuous control of liquid or gas streams. Records the ratio of any two wavelengths chosen. Thermostatted, enclosed in explosion-proof containers.



FOR THE PROCESS PLANT—*Model 105 TRI-NON* Analyzer* —Highly stable and sensitive. Suitable where there is considerable interference from stream components. Thermostatted, enclosed in explosion-proof containers.

*Trademark The Perkin-Elmer Corporation

Please send the bulletins checked

Model 14..... Models 93 and 105.....

NAME.....

TITLE.....

COMPANY.....

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The Perkin-Elmer Corporation, 830 Main Avenue, Norwalk, Conn.
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For Optical Design and Electro-Optical Instruments

PERKIN ELMER

In Two Years' Rugged Duty

"Never Down for Maintenance"

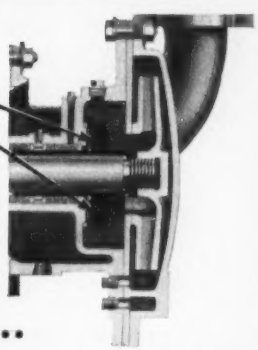
A-C Pump runs 4 times longer than previous unit ... *and still going strong*

A LARGE EASTERN CHEMICAL COMPANY is using Allis-Chalmers 4 x 3 PDE process pumps with *Equiseal* stuffing boxes to handle phosphoric acid water containing abrasives. These pumps operate 24 hours a day, 7 days a week. The unit shown above has been in use for approximately two years and *has never been shut down for maintenance.* The pumps previously used had to be completely reworked every six months and re-packed every three weeks. Naturally, maintenance costs have been drastically reduced.

Allis-Chalmers process pumps are available with or without *Equiseal* stuffing box, in a wide choice of materials to handle many types of abrasive or corrosive material at temperatures to 250° F. Every pump is individually engineered to each application. For details, contact your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 52B6615.

A-4395

Equiseal is an Allis-Chalmers trademark.

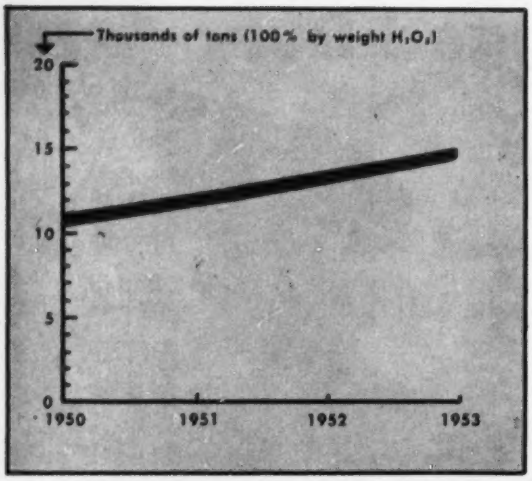


* *Why* this A-C feature prevents leakage...

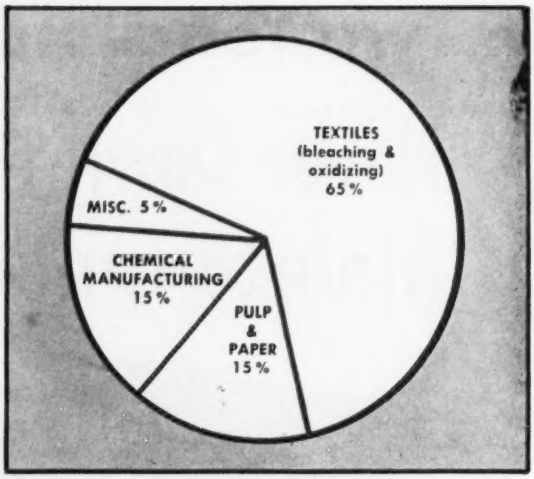
Many A-C process pumps have the *Equiseal* stuffing box. This is an auxiliary impeller which produces a low pressure area in front of the packing. This low pressure area prevents the liquid being pumped from entering the packing (on suction heads to 15 feet at 1,750 rpm). Equipped with an *Equiseal* stuffing box, an A-C pump will actually run without packing.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

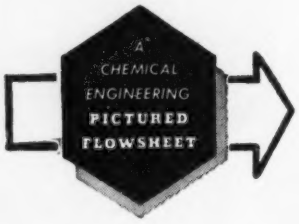


U. S. PRODUCTION of hydrogen peroxide. A steady climb.



USED AS A VITAL raw material in industry.

Current Hydrogen Peroxide



- **An important oxidizing agent and rocket propellant.**
- **Here is how Becco makes hydrogen peroxide.**

The world's supply of hydrogen peroxide is produced by four processes—one chemical and three electrolytic.

At the new Vancouver, Wash., plant, Buffalo Electro-Chemical makes this important chemical by an electrolytic process—oxidation of ammonium bisulfate solution to persulfate, and hydrolysis to the peroxide. This is the procedure used to make the bulk of H_2O_2, and is shown on the flowsheet.

The important reactions are:

ELECTROLYSIS

$$2NH_4HSO_4 \longrightarrow (NH_4)_2S_2O_8 + H_2$$

HYDROLYSIS

$$(NH_4)_2S_2O_8 + 2H_2O \longrightarrow 2NH_4HSO_4 + H_2O_2$$

▶**How It Works**—In operation, electrolysis is carried out in stoneware tanks—using platinum electrodes. The bisulfate (which is obtained as recycle material from the process) is converted to persulfate at the anode.

And the cathode liquor (after purification) recycles back to the cells.

The persulfate solution feeds to an evaporator, where —with steam—it hydrolizes to hydrogen peroxide and ammonium bisulfate.

▶**Concentration of Peroxide**—In a separator, bisulfate spent solution separates from the peroxide, and returns to the cells.

Dilute hydrogen peroxide then goes to stoneware distillation towers. Rectified hydrogen peroxide comes of the bottom of the towers—usually at a 30 percent concentration.

Water vapor passes to a condenser, where it is recovered as condensate.

Hydrogen peroxide boils at a higher temperature than water, and does not form constant-boiling mixtures with water. It is possible, therefore, to reach concentrations of as high as 90 percent, by fractional distillation. This has been done commercially by Becco.

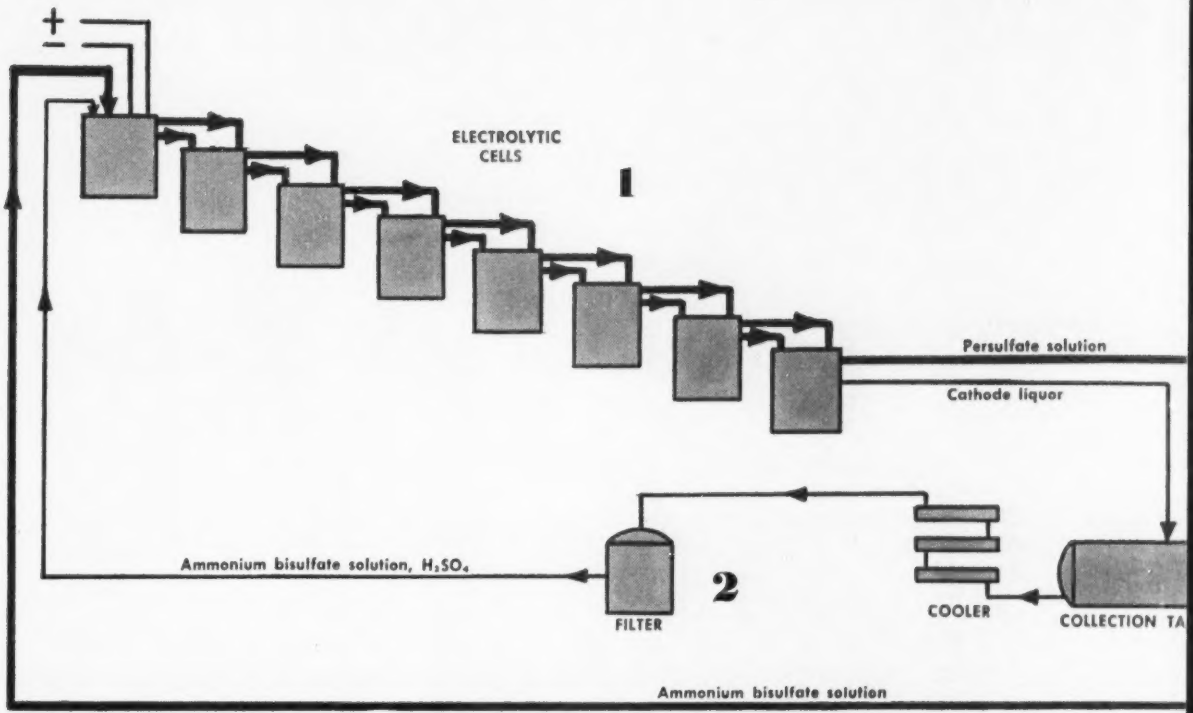
▶**What's It Used For**—In 1953, about 15,000 tons of hydrogen peroxide (based on 100 percent by weight) was produced in the U. S. by all manufacturers. Where does all this production go?

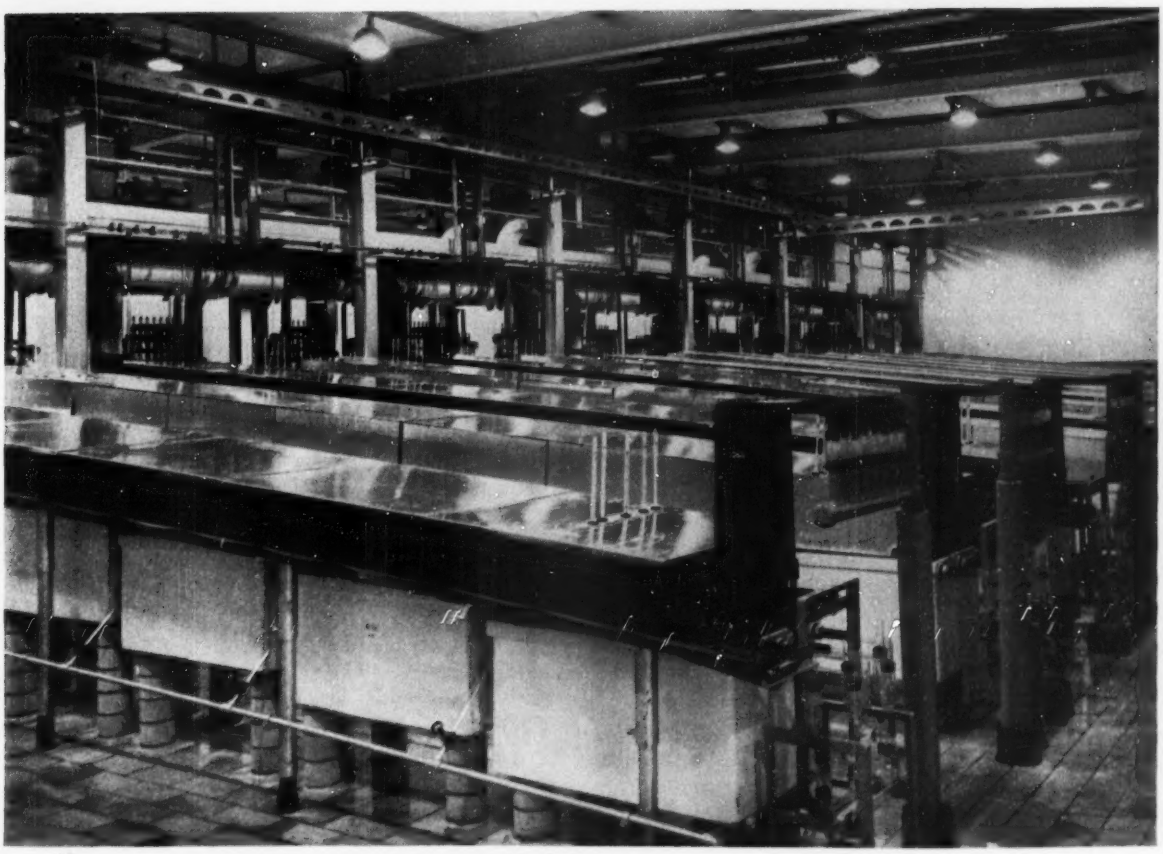
Bleaching operations takes a major slice of H_2O_2 production. Textile bleaching accounts for 65 percent. Hydrogen peroxide has a firm position in the textile industry. It gives a uniform bleach and permanent whiteness.

Another major outlet (15 percent) is in the bleaching of pulp—particularly groundwood pulp. It has only been in the last few years, that methods have been developed for bleaching pulps with peroxide—pulps that could not be bleached by the standard chlorine treatment technique.

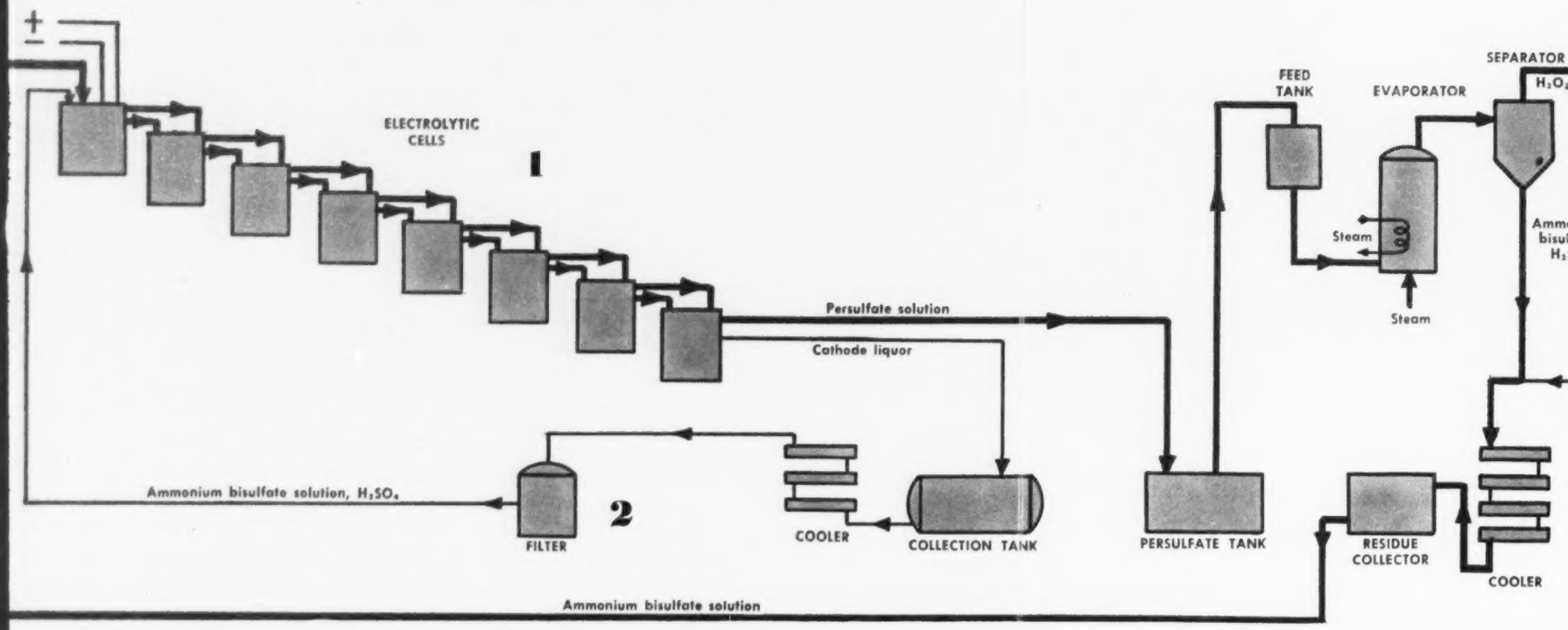
▶**Still Another Use**—Hydrogen peroxide (particularly concentrated) is used extensively in organic synthesis (15 percent). Dye, pharmaceutical, and insecticide manufactures put the oxidizing properties of H_2O_2 to good use.

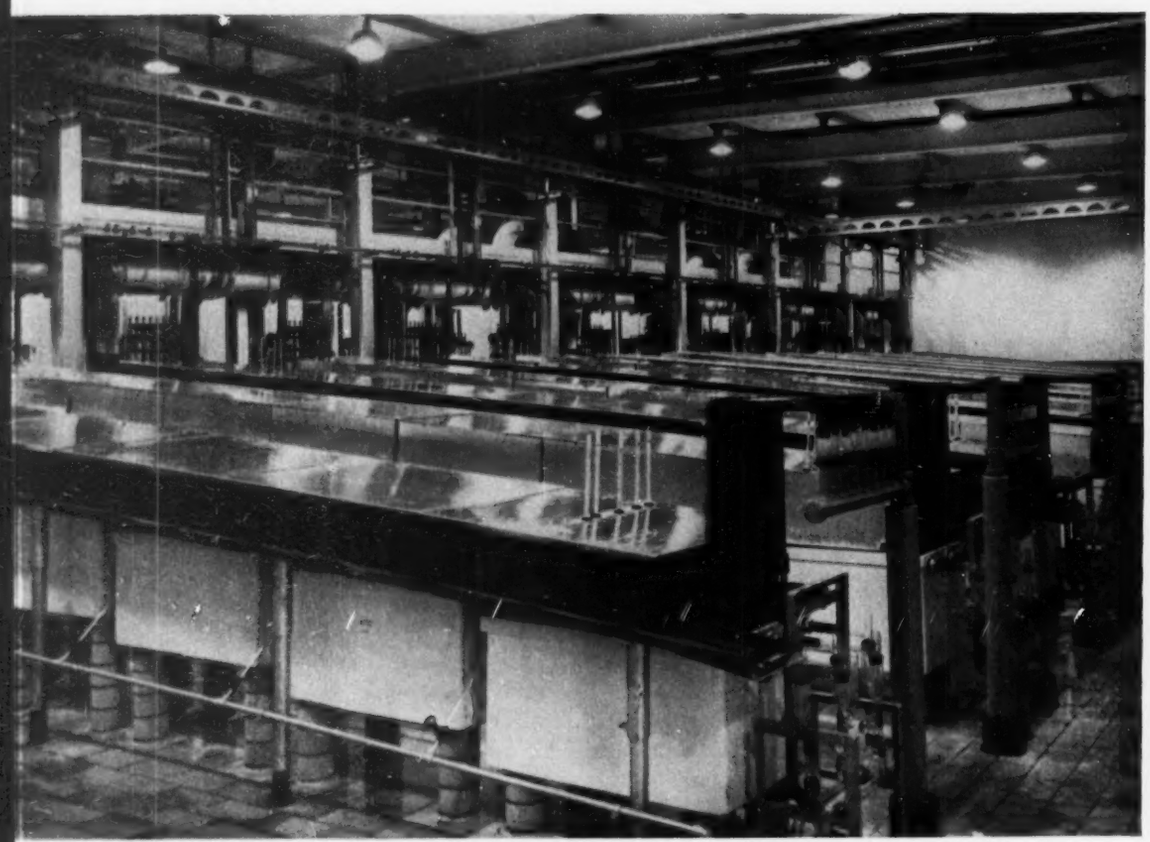
Of course, the military use of concentrated hydrogen peroxide—as a high energy rocket fuel—is under security regulation. But the demand, in this application, is not a small one.



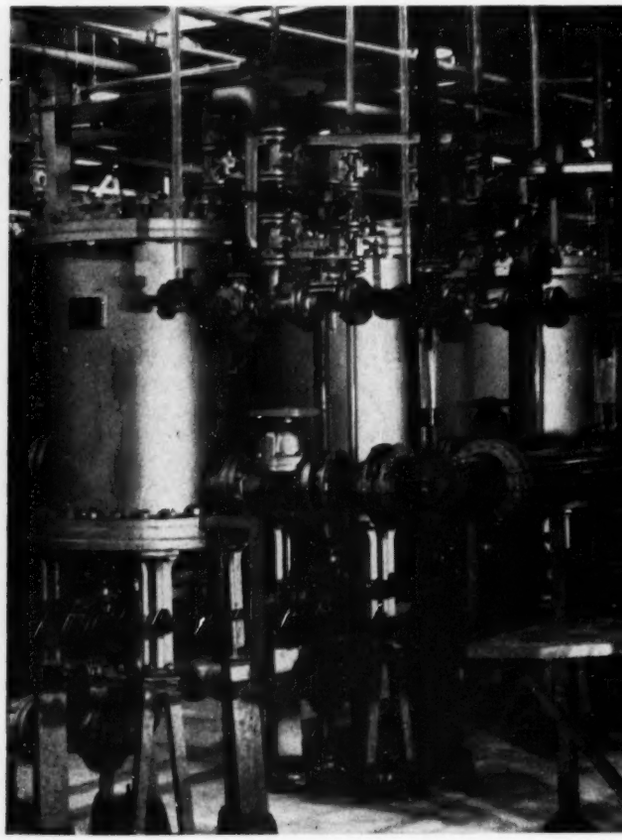


ELECTROLYTIC CELLS. Here ammonium bisulfate solution is converted to persulfate in stoneware electrolysis tanks.

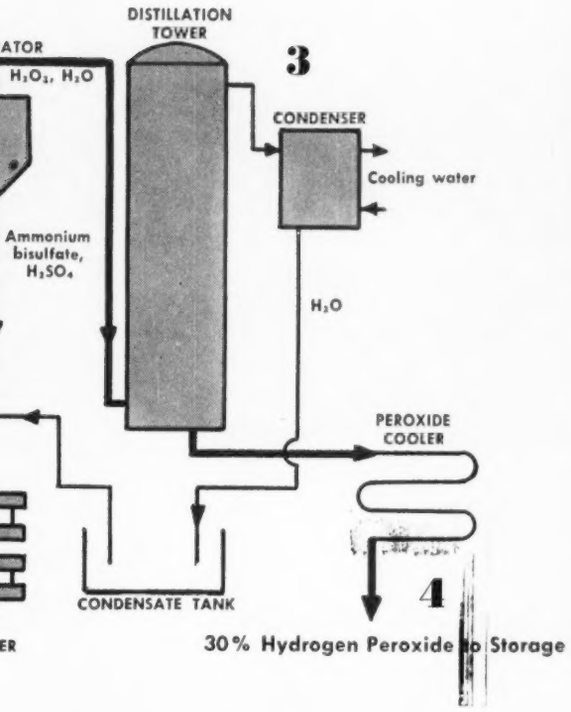


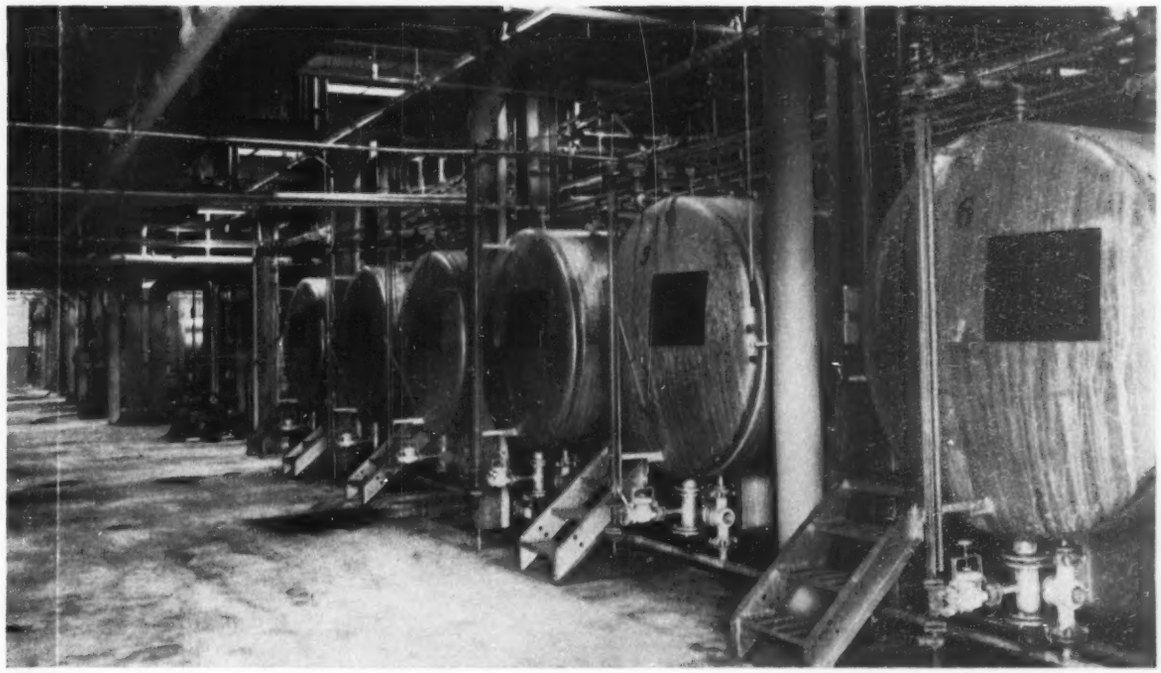


1 ELECTROLYTIC CELLS. Here ammonium bisulfate solution is converted to persulfate in stoneware electrolysis tanks.

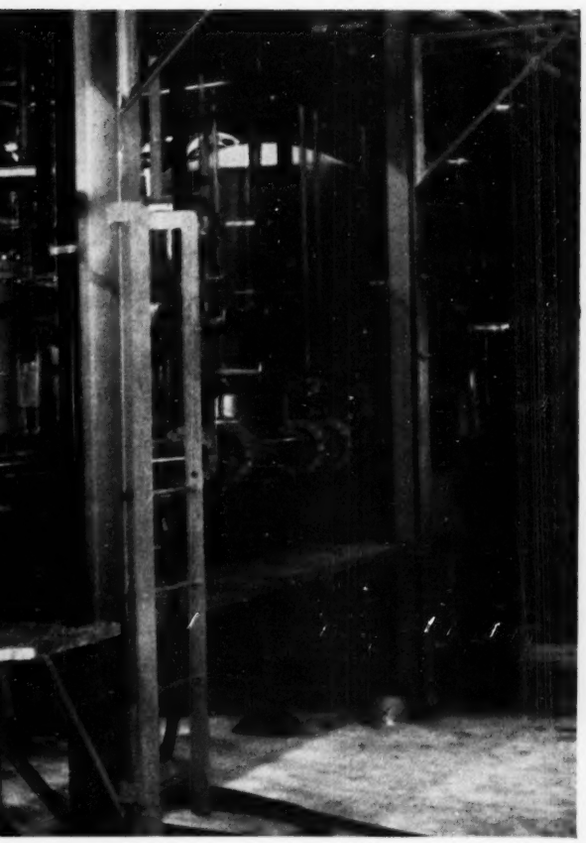


2 PURIFICATION FILTERS, where the cathode liquor is filtered,



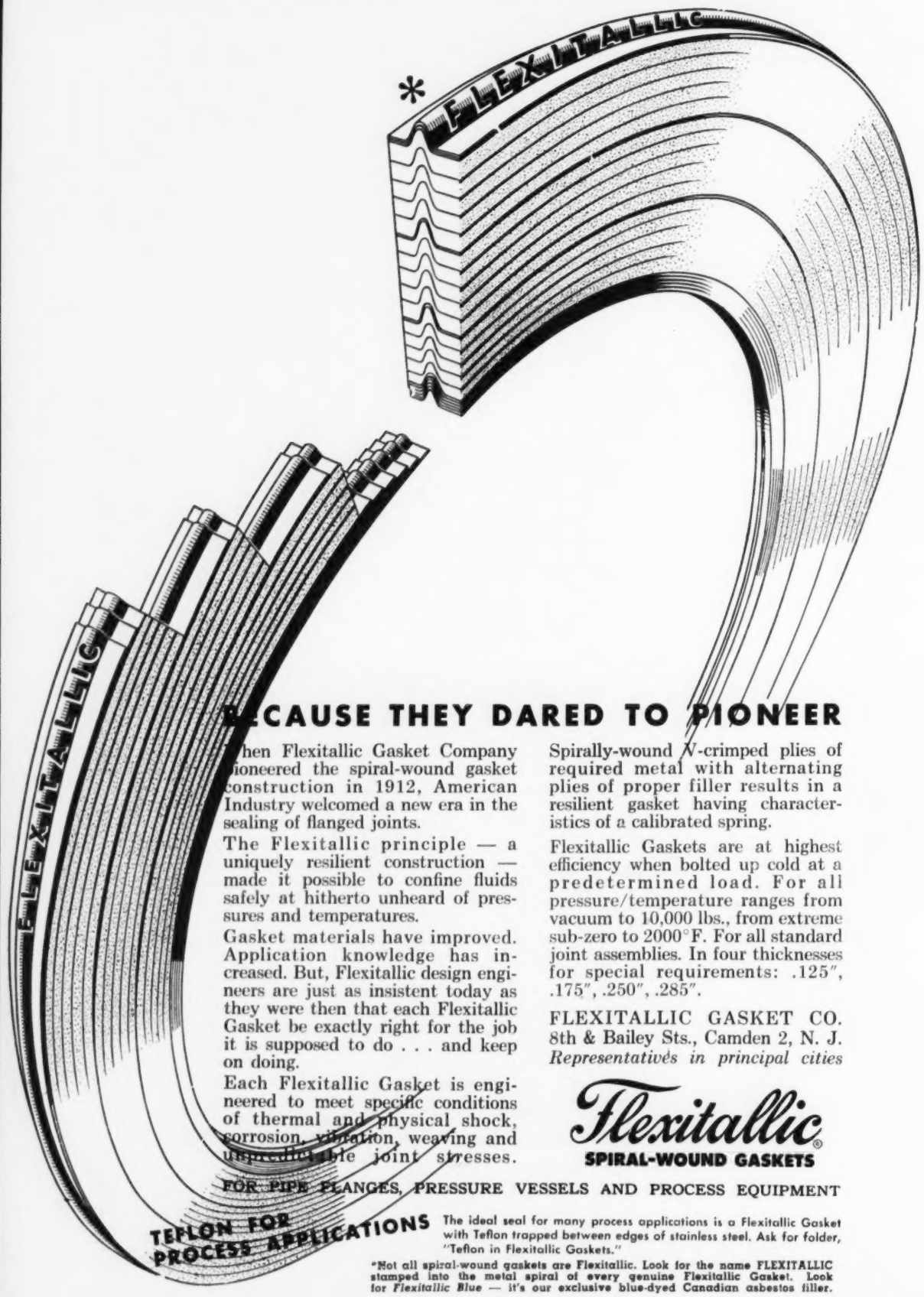


4 STORAGE TANKS—of high-purity aluminum—is used. Commercial H_2O_2 are shipped in aluminum drums, trucks and tank cars.



ered, to remove contaminants, and returned to the cells.

3 FRACTIONAL DISTILLATION concentrates the dilute hydrogen peroxide solution to about 30 percent and higher.



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Aluminum
Aluminu
Alums
Ammonia Gas
Ammonia Liquors
Ammonium Bisulfite (above 7.0 pH)
Ammonium Carbonate
Ammonium Chloride
Ammonium Hydroxide
Barium Cyanide
Barium Hydroxide
Bari

Carbon Dioxide, Dry
Carbon Dioxide, Wet
Carbonic Acid, Carbonated Beverages
Chromic Acid
Chromium Potassium Sulfate
Citric Acid
Coke Oven Gas
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Cresylic Acid
Solutions
dehyde
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Hydrogen Gas
Hydrogen Peroxide
Hydrogen Sulfide
Iron Chloride (Ferric)
Iron Chloride (Ferrous)
Iron Potassium Sulfate (Ferric Alum)
Iron Sulfate (Ferric)
(Ferrous)
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Magnesium Sulfate
Magnesium Sulfite
Mercuric Chloride
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Phosphoric Acid
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Sulfuric Acid
Sulfurous Acid
Tartaric Acid
Tin Chloride (Stannic)
Tin Chloride (Stannous)
Sulfate (Stannic)
Sulfate (Stannous)
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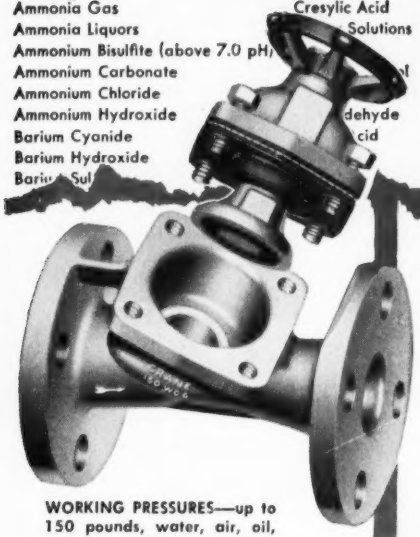

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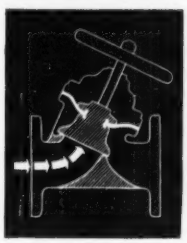

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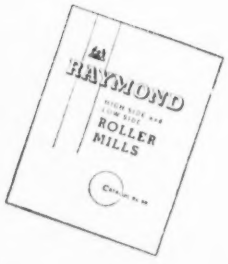

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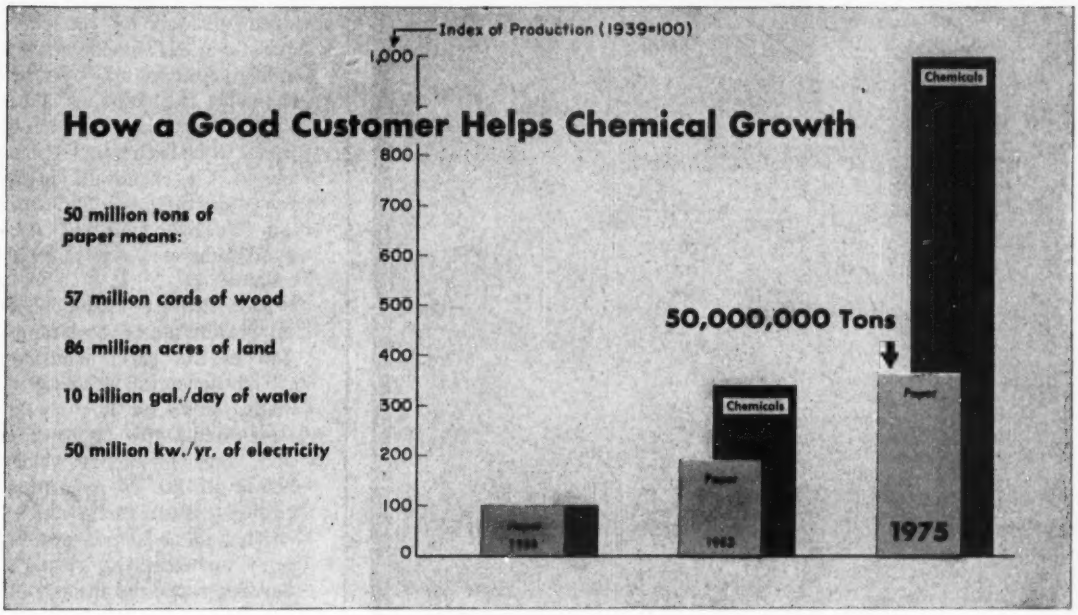

Paper Strides Boldly Toward New Records

With production doubled since 1939, and with still another two-fold increase expected by 1975, the paper industry is in the midst of its most dynamic era.

William H. Chartener, McGraw-Hill Dept. of Economics

Growth prospects of the chemical industry hinge largely on the growth of its customers. And the paper industry, one of the oldest major consumers of chemicals, promises to remain a lush, expanding market, with an even greater rise in the next two decades than that recorded since 1929.

An increase by 1975 roughly equal to the total paper and paperboard production in 1953—26,566,000 tons—was forecast at the recent annual invitational executives' conference of the Institute of Paper Chemistry in Appleton, Wis. This would represent continuance of a rising trend from 11 million tons in 1929 and 13.5 million tons in 1939 to the record figure of 1953. The industry's employment has virtually doubled from some 230 thousand in 1929 to nearly 450 thousand now.

▶ **Big Buyer**—Paper and allied products rank sixth among major chemical-using industries (other than the chemical industry itself), according to figures based on the 1947 Census of Manufactures. The value of chemicals consumed by the paper industry in 1947 is estimated at $183 million. In 1953 it was probably close to $300 million.

Papermaking involves not only a large volume of chemicals, but also a wide variety. Chlorine is used for bleaching; caustic soda, sulfur dioxide and sodium sulfate for digesting wood to pulp; and numerous compounds for coating, sizing and other treatment of paper. New papers developed in recent years rely heavily on chemicals for their special qualities. Synthetic resins, for instance, add greatly to water resistance and wet strength.

▶ **Interdependency Counts**—The paper industry, like chemicals, will depend on rising sales to other growing industries for much of its own expansion. Almost half of the total tonnage production of paper and paperboard is used for wrapping, packaging and containers.

In this use, paper and paperboard production are closely keyed to industrial production in general and will rise as the nation's production increases. And because so much of it is used for containers by all types of industry, paperboard production is regarded by economists as a sensitive indicator of industrial production.

The chemical industry itself is an outstanding instance of the

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ECONOMICS . . .

effect advancing production will have on the demand for paper and paperboard. Purchases of paper and allied products by the chemical industry in 1947 amounted to $331 million, exceeded only by purchases of food and kindred products among all outside industries from which the chemical industry bought. The chemical industry depends on the paper industry not only for packaging but also for wood pulp as a raw material for cellulose.

▶ **More People**—Population growth will provide another basis for expansion of the paper industry. Although newsprint, book paper and writing paper are not among the most rapidly growing paper products, they fill needs which are bound to rise as population increases. Construction, which will respond to population growth, insures an increasing market for building paper and insulation; this classification now accounts for one-tenth of the paper tonnage produced annually.

▶ **And New Markets**—More dramatic as a factor in the growth of the paper industry is the development of new products and the cultivation of new markets for paper.

In only the last few years, paper containers have largely replaced glass bottles for store sales of milk, and stronger paperboard has been used for boxes that formerly had to be made of wood. Experiments are now underway that may open a lush new field for paper in canning beer. Paper bathing suits so far have been developed only to the extent necessary to stimulate the imagination of comedians, but even this use may lead to another vast market for paper as a substitute for textiles.

In the development of new and improved paper products as a basis for expanding the industry's markets, the paper industry relies heavily on chemical research. The recent conference at the Institute of Paper Chemistry heard the exciting suggestion that it may soon be practicable to use synthetic fibers, rather than vegetable fibers, in the manufacture of paper. Undoubtedly this would impart to

paper—just as synthetic fibers have imparted to textiles—a whole range of new qualities and would open the way to new uses and new markets for paper.

▶**Need Raw Materials**—The expected growth of the paper industry over the next 20 years will bring with it some enormous problems which this industry, and those that serve it, must face. On the assumption that paper and paperboard production will double to 50 million tons in 1975, speakers at the Appleton conference saw staggering increases in the demand for cordwood, water and electrical energy.

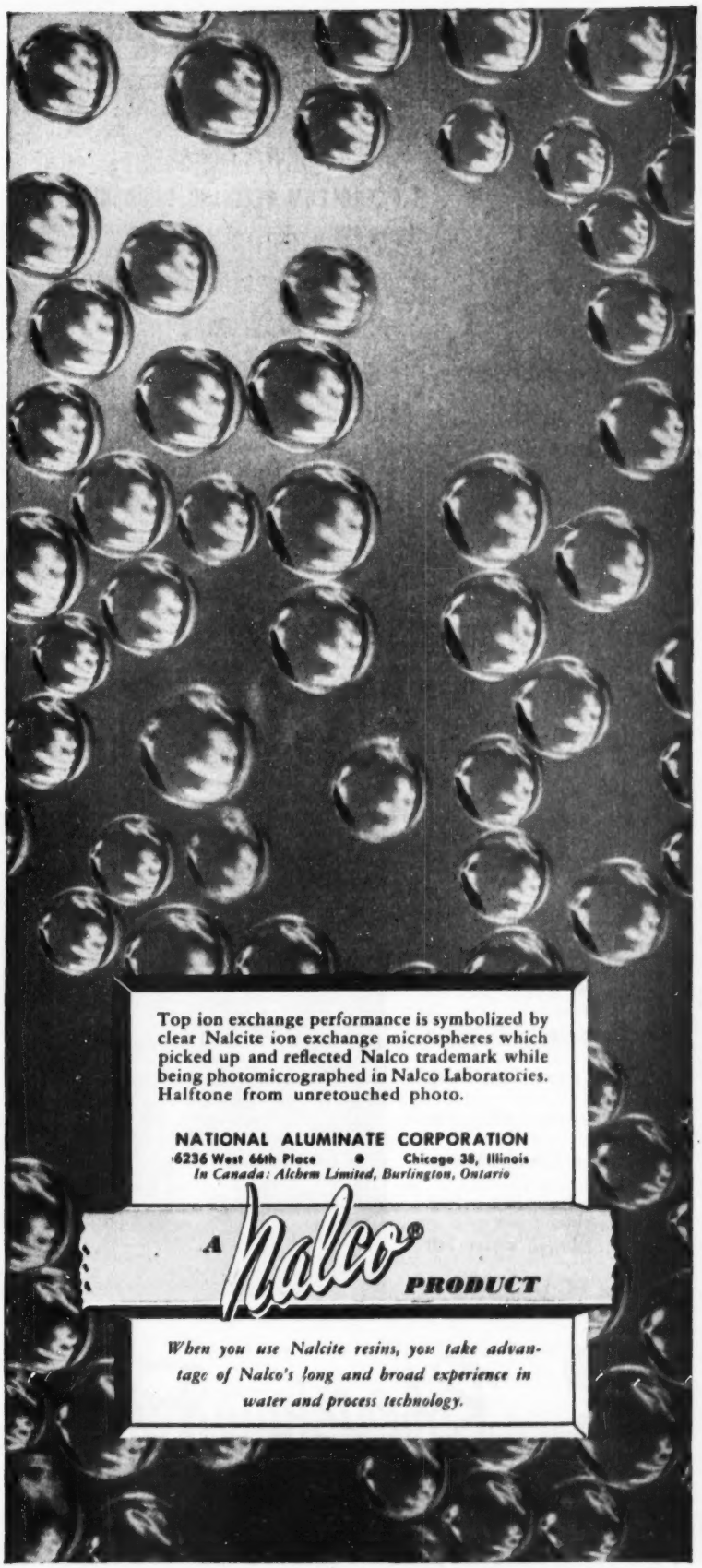
The demand for cordwood, it was suggested, would rise to some 57 million cords a year. Growth rates for timber would require a land area of 135,000 square miles—five times the forest area now owned or leased by the paper industry—for continuous operation of the industry.

Water requirements would rise to 10 billion gallons a day, more than the total amount of water used for all purposes in the State of New York in 1950. Electrical energy needs might approach 50 billion kilowatt hours a year, roughly one-fourth the amount used in all manufacturing in 1952.

These mounting demands on resources, some of which will be subjected to severe pressure from other industries, underline the necessity of research aimed at conservation and more efficient use of materials. Genetics will help in increasing the yield of forest lands. Chemistry should aid in improving control over insects, disease and fire. Chemistry will also play a great part in efforts to increase the utilization of wood, only 40 percent of the tree (by weight) now finding its way into paper.

▶**Hope for Water**—The water problem is not one of dead loss. Actually, less than 1% of the water used in manufacturing paper is lost in the form of vapor; the rest is returned to streams. Multiplied paper production, consequently, will not mean that any considerable amount of water will vanish.

However, the questions of distribution and condition of available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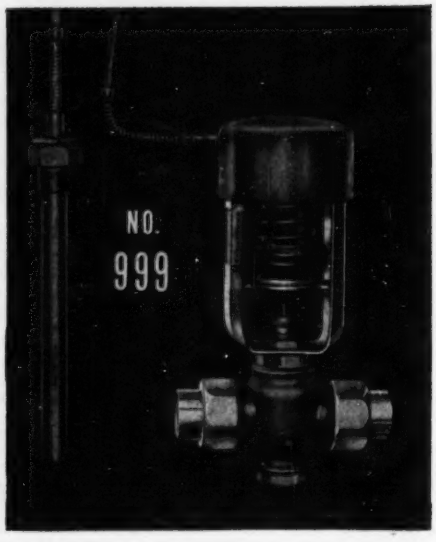

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water are very serious ones. Chemical research may provide the answers in the form of economical methods of treating water for re-use by the paper industry and of combatting pollution to preserve water for other users.

In the matter of electrical energy, much of the power now required is for the refining process. The question was raised at the Appleton conference of whether chemical and biological processes might be substituted for present mechanical techniques, yielding a saving in energy requirements.

Chemical treatment through the chemi-groundwood process, it was reported, now saves perhaps 50% of the energy otherwise needed in the grinding of wood. Research on fiber treatment would benefit the paper industry not only by holding down its huge energy requirements but also by adding further to the development of the new and improved products which are so important in the industry's growth.

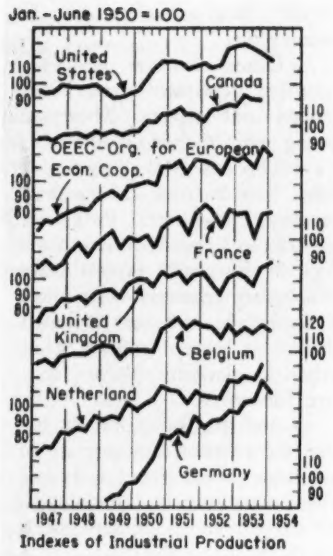
American Dip Not Followed Abroad

For more than a year countries of the Free World have lived in dread of a U. S. business recession. Because of the importance of this country in world markets and memories of what happened in 1929, 1937 and 1949, it has been taken for granted that even a mild slump here would have calamitous effects on other economies.

The experience in 1949 was particularly frightening. At that time a mere leveling off in the rise of U. S. national product and a drop of 10% in industrial production was enough to cause severe economic quakes abroad.

Haunted by these precedents, foreigners have conjured up the spectre of mounting unemployment and new currency troubles—all threatening their hard-won gains toward internal recovery, freer international trade and convertible currency.

►**It Didn't Happen**—Today the U. S. recession is a reality. Rise in national product has not only leveled, but slipped a little. Indus-



trial production index is down about 10%. American imports during the first quarter of this year were off about 10% from the first quarter of 1953—about the same decrease experienced in 1949 over 1948.

Yet the dire predictions of the effects on the rest of the world have not been borne out. With a few minor exceptions, as shown graphically above, industrial recovery abroad has held up or moved ahead. Similarly, economic conditions are looking up in many non-European countries, including Australia, India and South Africa. ▶ **Why?**—According to the National City Bank of New York, which prepared this study, there are six major reasons why the predictions went haywire.

• Expectations of the impact of a business decline on American imports were probably exaggerated.

• European monetary conditions are much better than in 1949. Inflation has been checked, prices are more competitive in world markets, money is sounder and currencies are fortified by large reserves.

• Production in Western Europe rests on a broader base. Elimination of rationing, tax reductions and relaxation of credit

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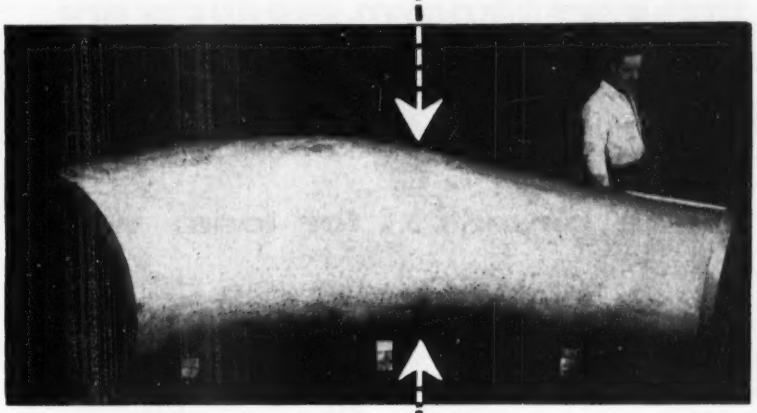

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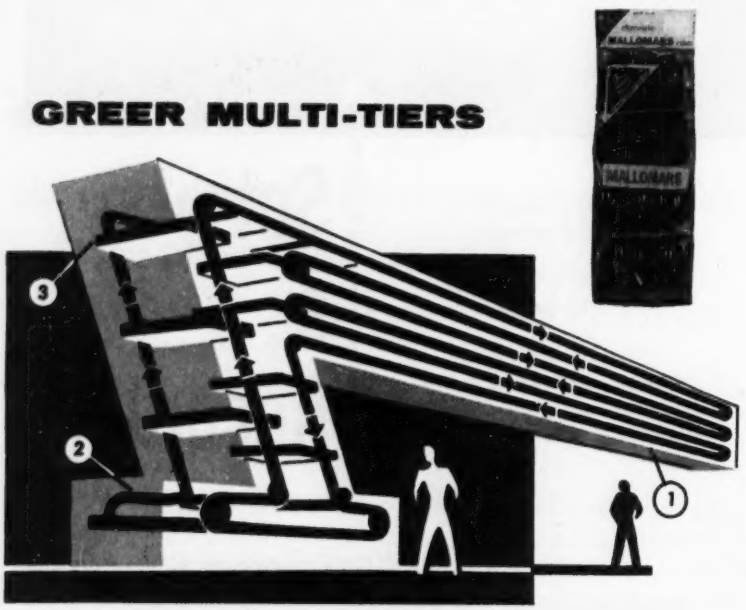

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restraints have given freer rein to consumption.

• Other countries have become less dependent upon U. S. imports and exports. They are trading more with each other.

• The so-called "terms of trade" have been in the favor of European countries. Prices of manufactured goods which bulk large in European exports have been higher, relatively, than prices of food-stuffs and raw materials which bulk large in imports. Thus exchange positions have been strengthened.

• And highly important has been the continued outpouring of American funds for travel and other private services, economic aid and support of our military efforts and those of our allies.

In sum, then, the notion that a mere ripple on the surface of the U. S. economy is enough to produce tidal waves elsewhere has been dispelled. The Free World has stood the test well.

Chemicals Bulk Large In Investment Houses

America's chemical industry is one of three major U. S. industries, whose shares are most widely held by 175 investment companies with combined assets over $5.5 billion. This fact is but one of a multitude in the 1954 edition of "Investment Companies," issued annually by Arthur Wiesenberger & Co., member of the New York and American Stock Exchanges.

As of Dec. 31, 1953, chemical industry shares held by the investment firms amounted to 5,100,000 with a value of $284 million. Of the other two leading industries, petroleum has 16,000,000 shares with a value of $723 million and utilities, 29,200,000 shares valued at $950 million.

Three major reasons are given for selecting chemical stocks: above average growth over past years; strong working capital positions and relative earning power stability; relative assurance of continued strong, well-above-average growth indefinitely in the future.

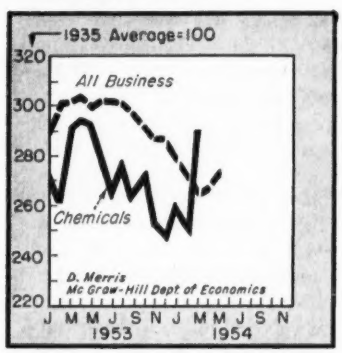
Naugatuck Expects 25% Sales Increase by 1956

Celebrating its fiftieth birthday this year, the Naugatuck Chemical Division of U. S. Rubber Co. is enjoying the fastest growth of its career. Production is now valued at more than $100 million a year, 125% greater than in 1946, 250% above 1940 and 500% over 1935.

The current expansion program, says John E. Caskey, vice-president, will add about 50 million pounds of nitrile rubber, plastics and agricultural chemical production to the division's annual capacity before the end of 1954, bringing total capacity to more than 600 million pounds of chemical products. This, he feels, gives the division a good chance to increase sales volume 25% by 1956.

CONSUMPTION INDEX . . .

CONSUMPTION . . .

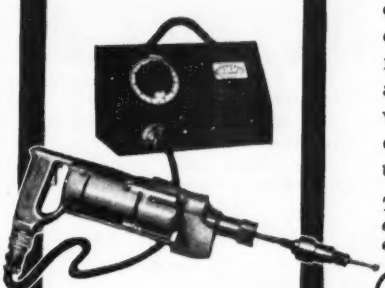


Business Activity (May)....274.0

Chemical Consumption

	April (Prelim.)	March (Rev.)
Index	**278.4**	**289.3**
Fertilizer	71.50	75.98
Pulp & paper	30.85	32.41
Petroleum ref.	26.57	27.91
Iron & steel	12.79	13.37
Rayon	24.51	25.32
Glass	23.83	25.19
Paint & varnish	30.05	28.33
Textiles	9.84	10.35
Coal products	9.76	10.66
Leather	3.90	3.86
Explosives	8 10	7.94
Rubber	5.95	6.20
Plastics	20.73	21.79

Airetool Series 6000 motors have ball-bearing thrusts front and rear . . . reducing friction to give more power. "Slip-fit" construction . . . no tools needed. Single expansion-type cutter head rapidly and thoroughly cleans coke from straight tubes.



Tube ends in condensers and heat exchangers are automatically rolled to consistently accurate, tight joints with the Airetool Automatic Tube Expansion System. Precise control eliminates over-expanding of tubes and distortion of tube sheets; provides maximum bonding to insure trouble-free tube joints.

When production lags, profits quickly go down! Keep your production at high levels by eliminating expensive shutdowns due to tube failure . . . simply and easily . . . by using Airetool Tube Cleaners and Expanders regularly, to keep your tubular equipment at peak efficiency. Powerful Airetool motors permit the use of any combination of cutter, drill or brush cleaner heads; safely, completely removing all types of scale, coke, or other foreign deposits from straight and curved tubes of any diameter or radius. If your tube problems are causing your production worries, our tube maintenance experts can help you! Write to us today.

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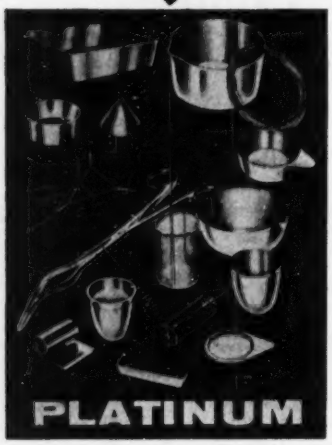

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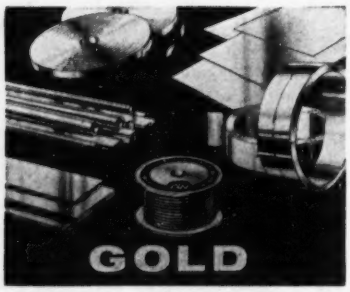

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THIS MONTH'S

Names in

Carl F. Prutton

Vice president and technical director of the Chem. Div., Food Machinery & Chemical Corp., N. Y., Dr. Prutton was formerly head of the Dept. of Chemistry and Chem. Eng. at Case Inst. of Technology. He was later associated with the WPB, Dow Chemical Co., Lubrizol, and finally Mathieson Chem. Corp., of which he was vice president and director of engineering and research operations.

Walter J. Reppe—West German professor of chemistry who will visit Carnegie Inst. of Technology in October under a grant from the Koppers Co. Dr. Reppe is a director of Badische-Anilin & Soda-Fabrik A. G., Ludwigshafen, Germany (one of three companies formerly constituting I. G. Farbenindustrie). His chemical discoveries, especially in acetylene processing, have been widely recognized throughout the scientific world.

Frank L. LaQue—Vice president and manager of Devt. and Research Div. of the International Nickel Co., succeeding **Thomas H. Wickenden,** who continues as consultant to the company.

William T. Cave—Group leader in charge of spectroscopic activities in the chem. research dept. of Monsanto's Research and Eng. Div. in St. Louis.

the News

P. Shaw

Thomas P. Turchan–Manager of manufacturing for American Cyanamid Co.'s agricultural chemicals division.

Roy S. Ericson–Assistant manager of tech. service dept. in the Mich. Alkali Div. of Wyandotte Chem. Corp.

Donald A. Buchanan and **Clement H. Darby Jr.**–Recent chemical engineering graduates appointed to the staff of Hooker Electrochemical Co., Niagara Falls.

John T. Cox, Jr. and **W. Whitney Weinrich**–Consulting chem. engineers in rubber, chemicals and petro-chemicals field, establishing an office at 1518 K St. NW, Washington, D. C.

Kenneth Kasschau–Manager of engineering of the new atomic energy projects dept. of the American Locomotive Co.

J. W. Zabor–Assistant to W. K. Menke, vice pres. in charge of chemicals, Pittsburgh Coke & Chem. Co., Pittsburgh.

T. S. Carswell–Elected director of Commercial Solvents Corp., of which he holds title of vice president in charge of biochemicals.

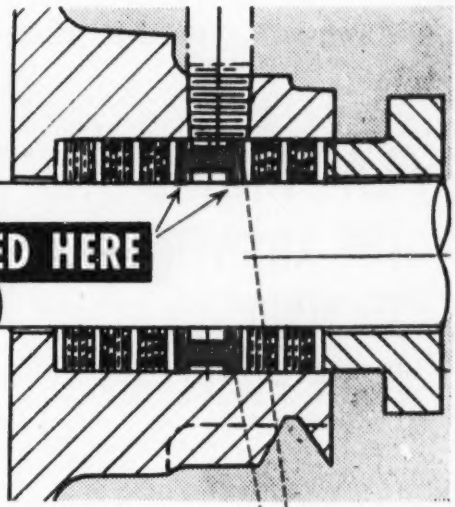
Walter Murken–Production manager, Quaker Rubber Corp., division of H. K. Porter Co. Inc., Philadelphia.

Edgar W. Engle–Manager of cemented carbide products engineering, Carboloy Dept. of General Electric, Detroit.

E. O. Ohsol–Director of research, Pittsburgh Coke & Chem. Co., the office held previously by Dr. Zabor.

Walter W. Bolton–President of Dryomatic Corp., succeeding **W. B. Heinz**, who will continue to serve on the board of directors.

THE LIFE OF YOUR PUMP SHAFT IS DETERMINED HERE



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for lubricating
or cooling
stuffing
box packing

Flexible Chempro Seal Cages do not score the shaft as do two-piece metal lantern rings or other types of metal seals. They save the expense of replacing badly scored shafts in pumps and other processing equipment operating continuously at high speeds.

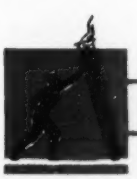
Machined in a single piece, Chempro Seal Cages snap easily over the shaft and *fit snugly.* No chance of movement or vibration even at very high shaft speeds. Their tough construction prevents bending or collapsing under extreme gland pressure.

For corrosive service, they are unbeatable – lasting many times longer than metal rings. They withstand continuous contact with acids, organic solvents, thionyl chloride, etc. – at normal and elevated temperatures.

Chempro Teflon Seal Cages are made in a wide range of sizes to fit most shaft diameters and stuffing box bores.

Write for complete Chempro Packing and Gasket Catalog.

* du Pont's trademark for its tetrafluorethylene resin



CHEMICAL & POWER PRODUCTS, INC.—
The Original Fabricators of Teflon Packings and Gaskets
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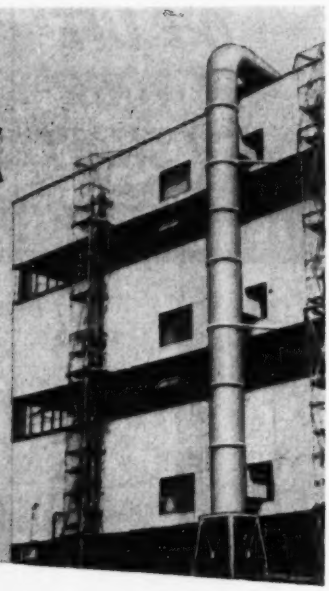
IS A PLA-TANK® STACK THE ANSWER TO YOUR FUME PROBLEM?



Shown here is a light-weight, easily-erected PLA-TANK stack which handles fume exhaust at the new thorium plant of the Lindsay Chemical Co., West Chicago, Ill.

The stack has a 44" diameter, is 69' long including 90° elbow, cross run to fan chamber and riser beyond fan. There are inlets from three floors to handle exhausts from individual tank systems. Stack was prefabricated with flanges for fast installation.

PLA-TANK STACKS may also be the answer to your problem of venting corrosive fumes — inside or out. Consider these many advantages.

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. . . competitively priced; available in diameters to 60"

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P-20

THE *Chemical* CORPORATION

61 WALTHAM AVE., SPRINGFIELD 9, MASS.

NAMES . . .

Mr. Bolton was formerly affiliated with Du Pont at its Savannah River Atomic Energy Project.

William Engs

Assistant to the president of Stauffer Chemical Co., N. Y. Mr. Engs held the position of manufacturing manager of the Agricultural Chem. Div. of American Cyanamid, with which he had been associated since 1941. He has a master's degree in chem. eng. from MIT and is a member of AIChE and ACS.

T. C. Keeling Jr.—Assistant vice president of the chemical division of Koppers Co. Inc., Pittsburgh. Mr. Keeling is rejoining Koppers after 14 months with the Mathieson Chem. Corp.

Semon H. Stupakoff—Vice president of Carborundum Co., Niagara Falls, formerly president of Stupakoff Ceramic and Mfg. Co. of Latrobe, Pa., which is now a division of Carborundum.

Robert S. Price—General manager of Seiberling Rubber Co. plastics division; previously he was associated with B. F. Goodrich.

Orville E. Isenburg—General manager, Harmon Colors, B. F. Goodrich Chem Co., Haledon, N. J.

Owen M. Cornell—West Coast manager of Paper Chem. Dept., American Cyanamid Co. in Portland, Ore., replacing **J. E.**

Garrison, who is retiring from the firm but will continue on a consulting basis.

R. K. Walters–Assistant manager of the manufacturing engineering dept. of Shell Chem. Corp., N. Y.

Morse G. Dial

President of Union Carbide and Carbon Corp. and recipient of the honorary degree of doctor of engineering from Stevens Inst. of Technology, Hoboken, along with **Vice Admiral Edward L. Cochrane** (USN retired), vice president of MIT.

H. E. Carter–Head of the Dept. of Chemistry and Chem Eng., University of Illinois, effective Sept. 1. Dr. Carter, now head of the biochemistry division, will succeed **Roger Adams,** who is retiring as head but will continue his research activities. A symposium honoring Dr. Adams will be held at the University on Sept. 3 and 4.

C. P. Boutte–Chief engineer of Shell Chem. Corp., superintending construction of the new plant at Norco, Louisiana.

Donald B. Benedict–Works manager of Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon.

R. H. Wellman–Assistant manager of Fine Chemicals Dept. of Carbide and Carbon Chem. Co.

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THE BARCO BALL JOINT is one of the most useful, most versatile fittings ever developed to provide *flexibility* in piping. The above photograph shows two stainless steel Barco Ball Joints used in making an extension type unloading line for sulfuric acid at a steel mill. This is but one of many installations in industry where Barco joints are used in handling corrosive acids, alkalies, solvents, steam, oil, air, gas, water, and practically all other fluids, *including white fuming nitric acid.*

BARCO BALL JOINTS offer many advantages over ordinary types of joints or flexible connections. When you want to be sure of getting SAFE, long-lasting, trouble-free installations, specify BARCO! Ask our engineers for recommendations. *Worldwide Sales and Service.* BARCO MFG. CO., 516I Hough St., Barrington, Illinois. *In Canada*: The Holden Co., Ltd., Montreal.

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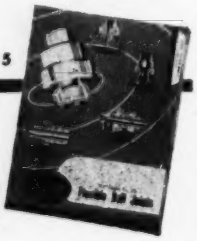

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THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING, AND REVOLVING JOINTS

THIS MONTH'S

Men of

John M. Olin

New board chairman and new president of the newest — and fourth biggest — chemical company, Olin Mathieson.

Well may the two gentlemen pictured above smile happily. They're both used to doing things in a big way, and they've recently put over what amounts to the biggest "deal" of their careers.

The just-completed merger of Olin Industries, Inc. and the Mathieson Chemical Corp. into the fourth biggest chemical firm, Olin Mathieson Chemical Corp., marks a giant step in a long march of acquisition and diversification by both firms. Sparking these marches are two ambitious, forceful, aggressive men, Olin's John M. Olin and Mathieson's Thomas S. Nichols.

John M. Olin graduated from Cornell University in 1913 with a BChE and went right to work in one of his father's many companies, Western Cartridge Co. He was the first formally trained technical man to join the organization—starting in as company chemist.

An avid hunter and marksman even then, John saw a need for and developed a new, progressive-burning, smokeless powder which, together shorter "shot string," upped the range of a shot gun by about twenty yards.

From this invention came the

the Month

H. T. Sharp

Thomas S. Nichols

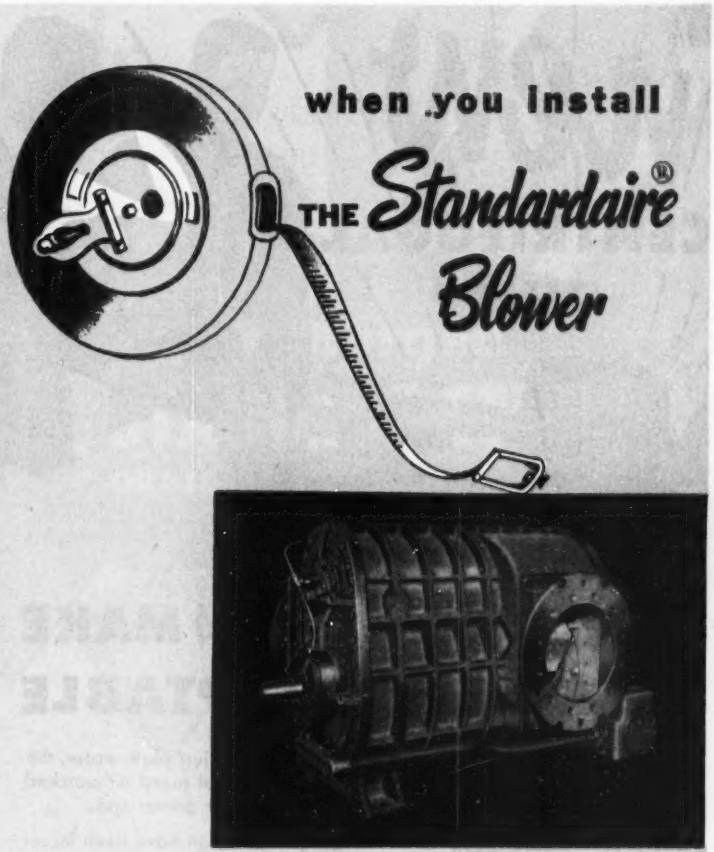
well-known Super-X shot-gun shells whose popularity pushed Western up among the top U. S. shell manufacturers.

He stepped briskly up through the ranks at Western and when that company bought out the Winchester Repeating Arms Co, he became its president. When he took over the reins at Winchester, he found the company in the red to the tune of some $8 million. His sound, heads-up management soon changed the tune and in a little over a year the company was operating at a profit.

This display of management genius was only a prelude for John Olin. Soon thereafter his father began to withdraw from active participation in the affairs of the company and John took over—just in time to lead the tremendous expansion necessary to provide small arms and ammunition for World War II.

In 1944, all of the many Olin-owned or controlled companies were consolidated into Olin Industries, Inc. This paved the way for greater diversification, which eventually brought the company into the paper industry (it supplies about 60% of the cigarette paper market) cellophane and gas and oil production.

In the little free-time that is left to him from his many administrative duties John enjoys nothing



you'll have space to spare

You'll marvel at the proportion of floor space used to blower output by this compactly designed, highly dependable unit. The *Standardaire* Blower is precision manufactured to move more gas or air with less wear than other blowers of equal size or weight . . . and does it with less maintenance and power costs, too.

The *Standardaire* Blower employs the proved principle of compressing gas or air on a modified adiabatic cycle. This enables *Standardaire* to offer you a wider range of pressures with less internal losses. High pressure gases and air are confined to the discharge end of the blower, because of the continuous sealing operation throughout the entire length of the *Standardaire* accurately machined rotors. Thus, leakage lines are shorter, and shock-pockets of air or gas eliminated.

Write today for further information on *Standardaire* Blowers . . . get your copy of the new Blower bulletin.

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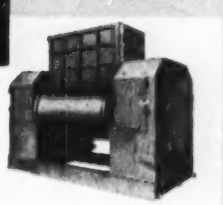


new CENTRIFUGAL PUMP

Optional features MAKE IT WIDELY ADAPTABLE

From a tough liquid handling problem to pumping just plain water, the new Deming Fig. 4011 series end suction centrifugal pump is "matched to the job" with the proper liquid end and proper power end.

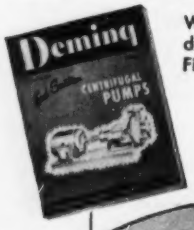
Many years of experience in centrifugal pump design have been incorporated in this pump to make it an outstanding addition to the Deming line of centrifugal pumps. Some of the many features are:—

Semi-open, non-clogging type impellers of extra heavy, three-vane construction; available with wiping vanes for handling special liquids.

Deep packed stuffing box with grease or water lubrication is furnished as standard construction. For special applications, various other types of stuffing box construction can be furnished including mechanical seals.

New four-piece separate liquid end assembly permits special construction in corrosion-resistant metals with the power end of standard material. Other optional features for abrasive or other special services can be supplied.

Sizes range from one through five-inch discharge with capacities up to 1000 gallons per minute and maximum heads up to 250 feet. Units are available with electric motor (as illustrated), gasoline or diesel engine driven, with pulley for belt drive or pump only.



Write for new Bulletin No. 4011 which contains complete details, illustration of construction and performance data on Fig. 4011 Deming End Suction Centrifugal Pumps.

THE DEMING COMPANY
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Specify DEMING PUMPS

better than hunting. A sportsman, as well as a fine marksman, he also works hard to increase the country's supply of game.

Although Olin and Tom Nichols have been close personal friends for years, their first joint business venture was undertaken about a year ago when Olin Industries and Mathieson formed the Matholin Corp. to make and sell hydrazine.*

The new partners hit it off right from the start. If Tom Nichols had a world of respect for John Olin and his achievements with Olin Industries, the feeling was certainly mutual.

Only 45, Tom Nichols' career has been truly meteoric. After leaving Cambridge High School in his native Maryland, he wasted no time in getting into the chemical industry. His first job was with the Du Pont Co. in Newark, N. J. By the time he was 24 he had worked his way to assistant sales manager of a Du Pont subsidiary company in New York.

He had been too busy being a success in business to take time out to go to college as a regular student, although he did attend night classes at the University of Pennsylvania.

In 1937, he left Du Pont to become vice president and director of Prior Chemical Corp. His vigorous leadership was a big factor in the considerable expansion which this small but successful company underwent in the following few years.

His abilities were beginning to be recognized more widely, and, even before Pearl Harbor, the government was calling on him for advice on matters pertaining to the chemical industry. When the war began he went to Washington to become one of the government's top $1 a-year men.

Tom's contributions went even beyond his work on the War Production Board and the various overseas missions in which he participated, for he was the author of the plan to rotate top industry executives in government positions. This plan of bringing experienced ad-

*Incidently, hydrazine was the subject of John Olin's senior research project when he was studying chemical engineering at Cornell.

ministrators into top government posts for a definite length of time was a tremendous aid to the country in that period of total mobilization.

After the war, he returned to his varied industrial interests, including Prior Chemical, which he again began to reorganize and expand.

In April 1948, at the age of 38, he was elected president of Mathieson and in July of the same year he became chairman of the board. At that time the company was primarily an alkali producer, albeit one of the biggest.

It didn't take long before the force and vigor of Tom's dynamic personality was felt up and down the line and the growth and acquisitions of the next six years boomed the company to a high spot among all chemical producers.

Even the task of building Mathieson couldn't keep Tom Nichols out of Washington when needed, however. During the Korean conflict he served as deputy administrator of the National Production Authority. He returned to Mathieson in July, 1951, in time to lay the foundation for the merger with E. R. Squibb & Sons, drug and pharmaceutical manufacturers.

Personable, dynamic Tom Nichols has been said to have an almost encyclopedic knowledge of the chemical industry. And he's parlayed this knowledge, ambition and lots of hard work into one of the top jobs in the industry.

And he may not be through yet. Both he and John Olin have Wall Streeters saying that there's "a psychological feeling that they want to be a second Du Pont."

George W. Merck, chairman of Merck & Co. Inc., and **Henry T. Heald,** Chancellor of NYU, were honored by Newark College of Eng. with doctorates in science.

S. K. Derderian—General manager of Metal Hydrides Inc., Beverly, Mass.

Ralph E. Gibson—First vice president of Armed Forces Chem. Assn., succeeding Rear Admiral Nathaniel S. Prime, retired, who

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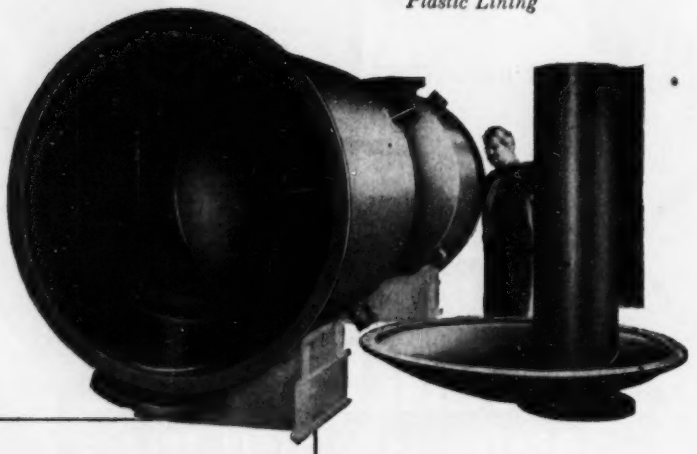

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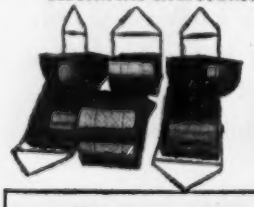

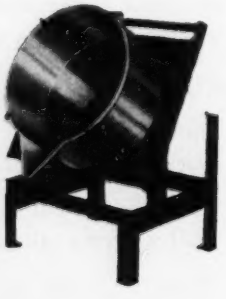

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NAMES . . .

becomes president. Dr. Gibson is Director of Applied Physics Lab., Johns Hopkins.

Clarence Barbre—Technical adviser in agricultural chem. field, Monsanto Co., St. Louis.

Ralph Martz—Superintendent of Diamond Alkali Corp.'s chlorinated products plant at Pasadena (Houston), Texas.

L. H. Dowell—Control div. manager for Phillips Chem. Co., wholly owned subsidiary of Phillips Petroleum Co., Bartlesville, Okla.

L. Leedy has been promoted to replace **Mr. Dowell** as assistant manager of the atomic energy div. at Idaho Falls.

Bruce Jones—Vice president of the Panhandle Oil Corp., Wichita Falls, Texas; promoted from position of refinery manager.

Albert D. Wagen—Assistant div. director of the Milwaukee Paint Div. of Pittsburgh Plate Glass.

George H. Fuller—Head of perfumery and essential oils div. of Colgate-Palmolive; formerly plant manager of Harriet Hubbard Ayer Inc.

OBITUARIES

C. Dudley Armstrong

Director and former vice president and secretary of the Armstrong Cork Co., C. Dudley Armstrong died early in June in

Haverford, Pa. at the age of 65. A grandson of Thomas Morton Armstrong, founder and first president of Armstrong Cork, he joined the company in 1910 following his graduation from Yale. He worked with Armstrong's Spanish subsidiary, and subsequently at the Lancaster and Pittsburgh locations. The Foreign Operations Division of Armstrong was revised and strengthened under his direction.

Joseph J. O'Neill, research chemical engineer for Goodyear Tire & Rubber Co., died at the age of 35 in Folsom, Pa., after a prolonged illness. Son of the late Joseph F. O'Neill, research chemist for Sun Oil and Sinclair Refinery, Mr. O'Neill had spent ten years in the paint industry as research and development chemist. He was an alumnus of Drexel Inst. of Technology and a member of the ACS.

Willis G. Green, 39, General Petroleum's senior chemical engineer, died May 23 following a heart attack. A resident of Alhambra, Calif., he was an expert on air and water pollution, serving on several committees dealing with these problems.

Ernest B. Benger, 68, authority on synthetic fibers and films and former director of the technical division of Du Pont's Textile Fibers Dept.

Sidney D. Wells, research associate at Inst. of Paper Chemistry, Appleton, Wisc., died in Baltimore on May 17.

Sam S. Headman, 66, senior partner of Headman, Ferguson and Corollo, Phoenix, Ariz., passed away on May 22. His firm was engaged in construction and expansion of domestic water and sanitary sewer systems in Phoenix and throughout the West.

Kenneth F. Cooper, 75, retired senior vice-president of American Cyanamid Co., died suddenly at Cooper Farm in Pine Plains, N. Y.

Each Kel-F lined rupture disc is given a leak detector test and must be proven pin-hole free.

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The use of Kel-F linings in combination with metals of known mechanical and metallurgical qualities such as Inconel, Monel, stainless steel and nickel means positive, trouble-free protection in highly corrosive applications heretofore impossible.

Thus, through "know-how" attained by years of experience in this highly technical field, BS&B has again provided the Process Industries with a *better* safety device for the protection of closed pressure systems!

BS&B Safety Heads

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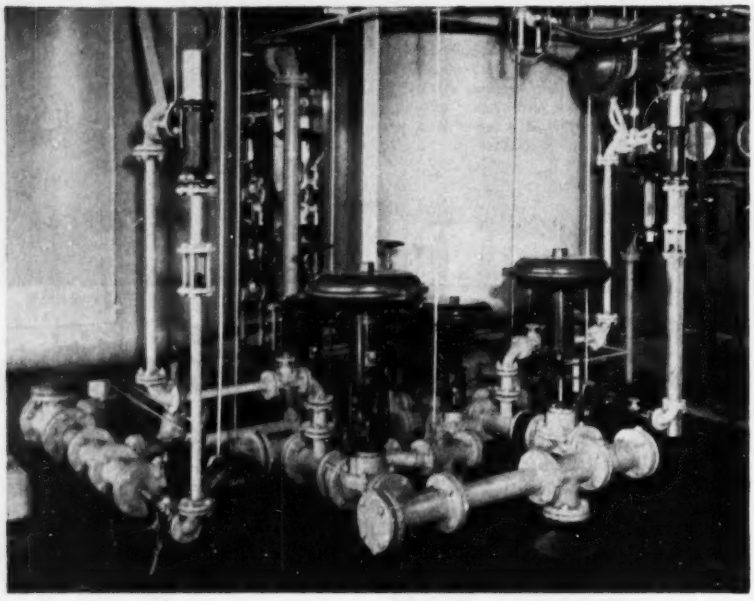
CORROSIVE LIQUIDS CAN'T HURT THIS INSTALLATION

Large midwest corn processor installs SARAN lined pipe, fittings and valves



When one of the largest processors of corn in the midwest was faced with the problem of handling corrosive liquid safely and efficiently in an ion exchange system, they investigated saran lined pipe and fittings.

They learned that saran lined pipe, fittings and valves assure tight, leak-proof joints. They were convinced that the excellent corrosion resistance of strong, rigid saran lined pipe would mean longer service and greater dependability. The sum total of advantages offered by saran lined pipe indicated that it would meet the company's demands for equipment that would assure uninterrupted processing free from the expense and inconvenience of unscheduled "shut-downs." Wherever piping with unusual resistance to most chemicals and solvents is involved, install saran lined steel pipe. It can be easily cut and threaded in the field without need for special tools or handling; costly down-time can be reduced to a minimum. We'll be glad to assist you with installation plans. Write THE DOW CHEMICAL COMPANY, Midland, Michigan.

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Please send me a copy of your catalog on saran lined pipe, valves and fittings.
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THIS MONTH'S

Letters:

New Unit Operation?

Sir:

Your magazine has been part of my professional experience since college days, and I have read with great interest your articles and editorials about technical, professional and ethical matters. Often I have thought of writing you in regard to some question raised in your pages on the American chemical industry—an industry which you have championed stoutly and valuably through the years.

Your March issue finally did it. On p. 178 you have an item: "A New Chemical Engineering Unit Operation is Born; Continuous Fractional Crystallization Gives p-Xylene" (by Phillips Petroleum).

Your writer may be impressed to the extent of trying to create "a new unit operation" from a commendable development. However, continuous fractional crystallization as a unit operation has been practiced here and abroad for a great many years. As an example I suggest you look at the flowsheet in American Potash & Chemical Corp.'s bulletin "Chemicals for Industry and Agriculture."

Having spent the greater part of my professional life with crystallization problems (including continuous fractional crystallization) it is my opinion that the unit operation of crystallization is a stepchild of the profesison. It is not even mentioned in Walker, Lewis and McAdams' "Principles of Chemical Engineering."

What is a salting-out evaporator? Is it a crystallizer unit without controls, and should the term be evaporator-crystallizer? What is a mechanical crystallizer then? And so on.

In other words, it is time, according to our point of view, that the terminology for the unit operation of crystallization be clarified.

HANS SVANOE
Struthers Wells Corp.
Warren, Pa.

▶ Yes, we did describe *Phillips'* p-xylene

Pro & Con

process as the new unit operation of continuous fractional crystallization.

Our definition is based on the understanding that a continuous mass transfer takes place between crystals of ever-increasing purity flowing countercurrent to a solution of eutectic composition.

By analogy we feel that the continuous deposition of crystals in a chamber (such as in the manufacture of phthalic anhydride) cannot be called continuous fractional crystallization any more than the flashing off of one component from a still pot can be called a continuous fractional distillation, even if bottoms are withdrawn continuously.

We agree with Mr. Svanoe that it's high time to clarify the terminology for the unit operation of crystallization. Any constructive ideas?—Ed.

More on Capitalized Costs

Sir:

While reading F. C. Jelen's very interesting article "Next Time Use Capitalized Costs" in your February issue, I noticed that with a few exceptions there was a consistent difference of 1.000 between the values of F and G in Tables I and II (p. 201).

Picking up my trusty Log-Log Decitrig (on which all the scales except the C and D have been gathering dust for lo, these many years), I checked the figures given for these exceptions and found that even in these cases the difference should have been very close to 1.000. The following values were in error:

	Shown As	Should Be
$F(50.3\%)$	1.326	1.295
$G(20.6\%)$	0.5531	0.453
$G(5.8\%)$	2.082	2.131
$G(10.16\%)$	0.300	0.293

Curious as to why the differences between F and G should be so uniformly close to 1.000, I checked algebraically and found there is a very good mathematical explanation:

$$F=(1+i)^n/[(1+i)^n-1]$$
$$G=1/[(1+i)^n-1]$$
$$F-G=[(1+i)^n-1]/[(1+i)^n-1]=1.000$$

Because of this simple relationship between the two factors, Table

versatile adaptability

. . . for all fine filtering

Versatile adaptability make this filter the logical choice of filtration engineers for difficult filtering problems.

Every filtering job usually presents an individual problem involving a combination of various kinds of screens, papers and filter aid. Frequently temperatures are encountered that call for a brine or steam jacketed tank. Linings; plastic or rubber may be needed, with tank and plate metals to fit the product such as mild steel, monel, nickel, stainless steel, bronze or Hastelloy. Constructed to meet ASME specifications when required.

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Constant filtering quality is maintained from start to the end of the cycle, no break through can occur in a Sparkler Horizontal Plate filter.

What other filter can match this versatility and positive performance under a wide variation of filtering conditions?

Place your filtering problem in the hands of our filtration engineers. They have developed many successful methods of filtering difficult materials and may be able to prescribe a solution to your problem without wasteful experimentation.

Write Eric Anderson for personal attention

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PRO & CON . . .

I could have been made to serve a dual function by letting it represent values either of F or of $(G + 1)$.

Table II could then have been eliminated entirely. This assumes, of course, that the average engineer is sufficiently adept at mathematics to calculate values of G by subtracting 1.000 from the value given for F. For those engineers who have lost the ability to perform mathematical operations without the aid of a slide-rule, I am pleased to state that it is possible to make this subtraction on the linear Log scale.

Incidentally, I found not only Mr. Jelen's article, but the entire February issue to be very well done. From every angle—format, writing standards, choice of subjects, editorial content—I think you are doing the outstanding job in the technical publications field. . . .

A. C. MALMSTEN
Cost Engineer
Sharples Chemicals, Inc.
Wyandotte, Mich.

▶ *For Mr. Jelen's answer to Mr. Malmsten's constructive comments, see the letter immediately below.*—ED.

Sir:

Mr. Malmsten has correctly pointed out that in my article "Next Time Use Capitalized Costs" in the February issue the F and G factors differ by unity, that is

$$G_m = F_m - 1$$

so that the table of G factors could have been eliminated.

The reason for not doing this was that the writer wanted every term in the main equations to be the product of a value times a single factor.

Although it might seem simple to use just one table it would mean that where F_m factors were wanted the table would be entered and the values read as seen, whereas if the G_m factors were wanted the same table would be entered and a mental subtraction of unity would be made, for that's probably the way the average person would do it.

It is simple things such as this which lead to confusion and errors. By having two tables the reader always uses the values as seen. How-

ever, it does introduce the possibility of the reader entering the wrong table, so I am not sure which plan is more advantageous. In any case, if the reader was given more than he needed it was intended for his benefit.

Mr. Malmsten is very thorough and has correctly pointed out four errors in the tables, namely

	Shown As	Should Be
$F(50,3\%)$	1.326	1.296
$G(20,6\%)$	0.5531	0.4531
$G(5,8\%)$	2.082	2.131
$G(10,16\%)$	0.3000	0.2931
and there is one other		
$F(2,2\%)$	27.75	24.75

F. C. Jelen
Chemical Engineer
Solvay Process Div.
Allied Chemical & Dye Corp.
Syracuse, N. Y.

Patent Pro & Con

Sir:

In each issue of *Chemical Engineering* you have a "Checklist of New Process Patents" which I have found very helpful.

However, your list for January was completely fouled up. You listed a process entitled "Acrylonitrile Production" as Patent Nos. 2,653,913-6 inclusive.

When I received the patents, they had nothing at all to do with acrylonitrile but were related to "reclaiming rubber." Also, Patent No. 2,654,761 listed as "Polymerization Controls of Acrylonitrile" was actually entitled "Iodinated Mercapto-Imidazoles." Likewise, No. 2,653,958 listed as "Elevation of Granular Solids" turned out to be "Method for the Continuous Purification of Soap."

I was chagrined and disappointed in your magazine. . . .

Charles B. Roen
General Development Dept.
Monsanto Chemical Co.
St. Louis, Mo.

▶ *We're chagrined at ourselves, too. But we're also pleased that our patent checklist was so helpful to Mr. Roen.*

Now that we've "unscrambled" the patents, they line up—properly—thus:
Acrylonitrile production 2,653,965-6
Polymerization of acrylonitrile 2,654,731
Elevation of granular solids 2,653,058

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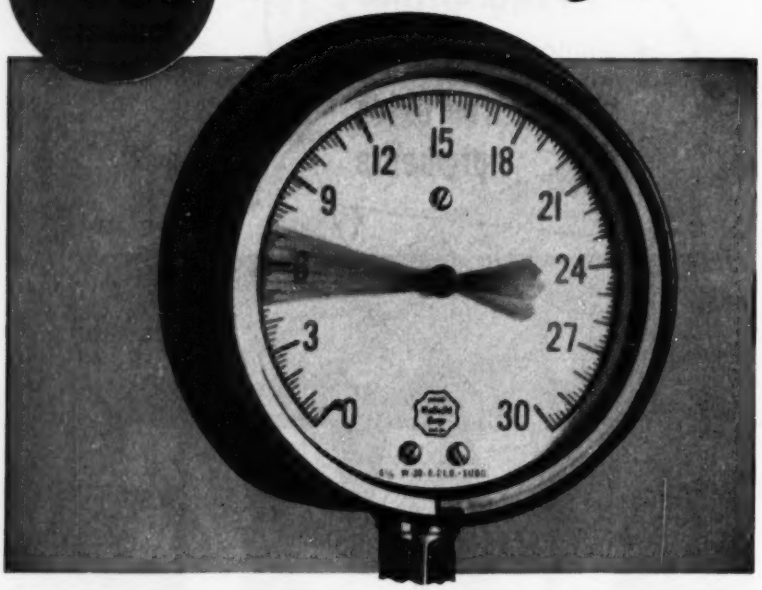

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THIS MONTH'S

Technical

International Technology

AN INTRODUCTION TO DRYING OIL TECHNOLOGY. M. R. Mills. Interscience Publishers, Inc., New York. 257 pages. $6.50.

Reviewed by G. McBride

The science and technology of drying oils have been touched on in a number of recent books dealing with vegetable oils in general, but there has not been a single book devoted to drying oils, specifically, for many years. Since the technology of expression, refining and treatment of these oils is significantly different from that of other vegetable oils, both because of the nature of the oils and because the processing is usually left to the specialist in the field, there is definite need for a book such as this.

The author takes up the manufacture and refining, the production of segregated oils, equipment for processing, boiled oil, bodied oils, both heat-bodied and blown, isomerized oils, esters of fatty acids, varnishes, and various chemically modified oils.

In the second part a brief review of the industries using drying oils, including linoleum, printing ink, and the paint industry is given, showing the special treatments given oils for each industry.

The author mixes what is obviously extensive practical experience in this industry with citations from the literature usually of fairly recent date, and generally, covering American practice. The principle emphasis given to British technology in which the author's experience lies, is the relative space accorded to various operations. Seggregated and isomerized oils each receive a chapter of about ten pages, while maleic-modified oils are given three pages in the general chapter on chemical modification—somewhat less than is given to sulfurized and to urethane oils. Other cases where the emphasis given to various processes is at variance with

Bookshelf

L. B. Pope

American practice might be cited, but, except for this and the use of British rather than American terminology for certain operations and products, the book is an excellent review of international technology. The whole emphasis is on the practical aspects of the technology of the art, with only passing mention of the theory behind it, but in its field it is an excellent example of how a book of this kind should be written.

Making & Breaking

FOAMS, THEORY AND INDUSTRIAL APPLICATIONS. By J. J. Bikerman with R. B. Booth, J. M. Perri, and C. C. Currie, Reinhold Publishing Corp., New York. 347 pages. $10.

Reviewed by N. Hackerman

The field which forms the basis for this book is one in which empiricism is rampant and in which there is certainly not less art than science. Furthermore, aside from the empirical character of much of the literature there is also available a goodly amount of misinformation. Dr. Bikerman has had extensive experience with the scientific and technical literature and he has shown the ability to evaluate such material critically. The material in this book is based also on the patent literature and contains references to a number of less readily available and less often read journals. The author's knowledge of the European literature is especially useful in a book of this kind.

In view of this background the rather large amount of material on foams the author has brought together can be taken seriously. It is convenient to have it in one place and it is useful to have it suitably organized and trustworthy. It is a compact book written in a succinct, perhaps somewhat staccato, style which is reminiscent of Bikerman's book on surface chemistry. The style probably makes it more

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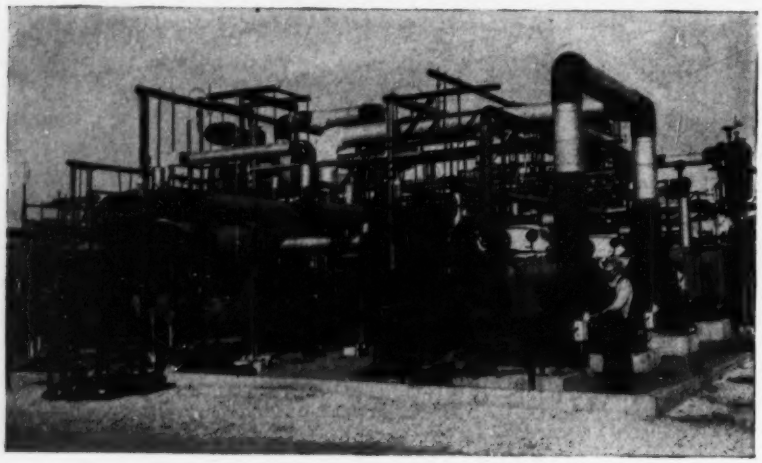
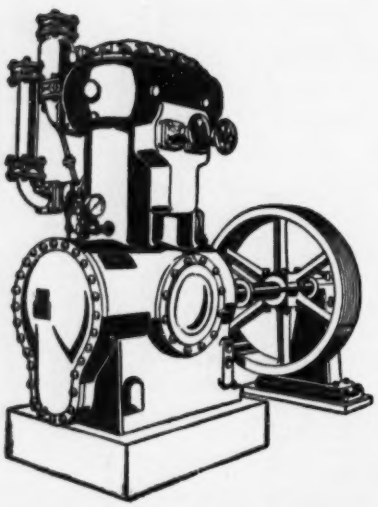
Below Right: **Three of the six Frick refrigerating machines in service at Big Spring, Texas.**



Para-Xylene { **A New Phillips Product** / **A New Application of** FRICK **Refrigeration**



Frick two-cylinder enclosed refrigerating compressor similar to those installed at Big Spring. Also, complete line of "ECLIPSE" multi-cylinder compressors for any refrigerant and any service.

Phillips Chemical Company's new plant near Big Spring, Texas, is the first in the country to produce 98% pure para-xylene (used in the manufacture of a synthetic fiber) in commercial quantities.

The new, revolutionary process, patented by Phillips, involves continuous fractional crystallization. The heart of the system is a Frick "cascade" low-temperature refrigerating plant that FREEZES OUT para-xylene crystals.

Whether *your* process is in the idea, development or production stage—if it involves refrigeration or air conditioning, get in touch with your nearest Frick representative, or write directly to

DEPENDABLE REFRIGERATION SINCE 1882

FRICK Co

WAYNESBORO, PENNA. U.S.A.

difficult to follow, especially for the casual reader. However, it should be quite useful to anyone even mildly interested in either research or development with foams.

The theory, structure, mechanism and properties of foams are considered in the first eleven chapters while three specific practical uses are given in chapters written by people who have direct experience in this regard. J. M. Perri deals with fire fighting foams, Robert B. Booth with froth flotation, C. C. Currie with chemical anti-foaming agents. A fourth chapter on miscellaneous uses, written by Dr. Bikerman, is also included. The make-up of the book is satisfactory and not many typographical errors were noted. An interesting variation is the use of numbered sections, often without titles. Presumably, this improves ease of reference without requiring the use of stereotyped titles in an effort to provide "newspaper headings."

In summary, this book can be recommended as one which should be available to all who are likely to be even remotely involved with the making, breaking, or using of foams.

Textile Testing

DETERGENCY EVALUATION AND TESTING. By J. C. Harris. Interscience Publishers, Inc., New York. 210 pages. $3.75.

Reviewed by C. L. Mantell

The author describes his work as follows: "The methods described have been found useful in years of experimental work and have generally been successful in weeding the potentially useful agents from those unlikely to be of value. Exception will be taken to the methods chosen, and suggestions to methods which have been proved more significant will be appreciated. Many of the minor phases of detergent testing have not been included either because they are still new and unproved, or because they have not been widely enough used to warrant their inclusion. Methods of proved utility may have been completely overlooked, but if so

this is entirely an error of omission and not premeditated."

The author has compressed into a book of 7 by 5 inches page size, screening tests, cotton washing tests, wool washing, surface cleaning, procedures for other fibers, tracer methods, and miscellaneous tests, in a useful volume which will be of considerable application value to those engaged in testing, particularly of a textile or detergency nature, and which might serve as a reference for those generally interested in the subject.

Metals

INDUSTRIAL INORGANIC ANALYSIS. By Roland S. Young. John Wiley & Sons, New York. 368 pages. $5.75.

Reviewed by Rex Robinson

As a chemist in an industrial laboratory the author has felt the need of a compact book on analysis to which an industrial analyst could refer rather than to the voluminous reference books now used, which contain many methods of analysis but recommend no specific one. Drawing upon his extensive experience in a mining and metallurgical laboratory, the author has presented in book form a selected group of important methods of analysis for about forty-two of the most commonly encountered metals and non-metals together with some miscellaneous procedures on water analysis, gas analysis etc.

As an introduction to the procedures for each of the elements, there is discussed briefly the element's natural occurrence, the main methods of separations in complex samples, certain points of manipulative technique and an assessment of the applicability and value of the various procedures listed.

The utility of the book has been extended further by noting certain special but less commonly used methods of analysis and listing references to the literature for those desiring additional information.

The reviewer believes the book will be of interest to analysts in general but of greatest value to those concerned with metals.

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HOT WATER

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POWERS

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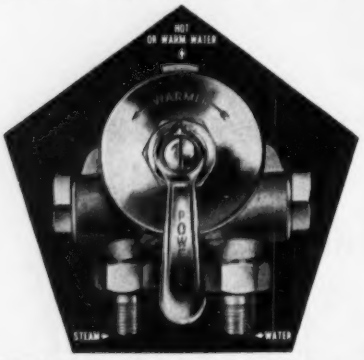
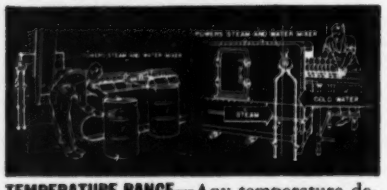


ECONOMICAL—Quickly pay back their cost. Thousands now in use. *Easy to install.* Requires steam and water pressures above 10 lbs. Steam is mixed directly with water.

MANY USES—Industrial processes; 180° F. sterilizing rinse water for dishwashers; washing oil drums, trucks, etc.



TEMPERATURE RANGE—Any temperature desired between that of incoming water and 200° F.

HAS PRESSURE EQUALIZING VALVE—which prevents delivery temperature changes caused by fluctuating pressures of steam or water.

SMALL SIZE—½" pipe size can be held in the palm of the hand, weighs 12 lbs., ¾" size weighs 23 lbs.

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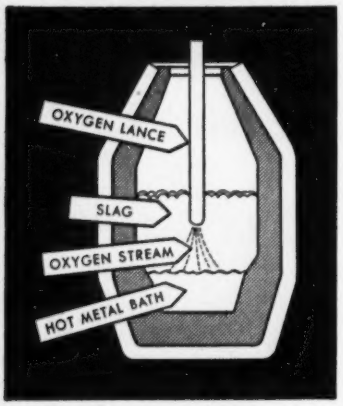
what's NEW in Engineering

To cut refining costs of steel, Kaiser Engineers has acquired the exclusive U. S. rights for the Brassert Oxygen Converter Process of producing high quality steel. Recognized as an advanced development



in steelmaking, the oxygen process promises a definite saving in refining costs of at least $3.00 per ton. Investment cost is also lower, as one 35-ton oxygen converter will produce as much as three 175-ton open hearth furnaces at half the estimated capital investment. Write us for a brochure describing the process in detail.

The largest construction contract in Australia's history has been awarded to the Kaiser-Walsh-Perini-Raymond group of American contractors. With Kaiser Engineers as the project's sponsor, the group will construct a dam and mammoth 14-mile water tunnel through the Snowy Mountains of Southeast Australia.

Asme Handbook Metals Properties. This is Volume I of a four volume handbook sponsored by The Metals Engineering Handbook Board of the American Society of Mechanical Engineers. Published by McGraw-Hill, METAL PROPERTIES tabulates strength, hardness and the other properties of over 500 metals.

Whatever your immediate research, design or engineering problems, however unusual they may be, an early consultation with Kaiser Engineers is an important step toward their quick, profitable solution. Call or write Kaiser Engineers Division of Henry J. Kaiser Company, Kaiser Building, Oakland 12, California.

THIS MONTH'S

Recent Books

Naval Stores

A government pamphlet of statistics on turpentine and rosin. There are production figures for 1952 through 1953. Also stocks of turpentine and rosin in eastern, central and western parts of the country are listed for 1953 and the first three months of 1954. 12 pages.

"1953-1954 Annual Naval Stores Report." Superintendent of Documents, Government Printing Office, Washington 5, D. C. No charge.

Company Standards

Well conceived programs of company standards can increase efficiency. This is the main thesis of this little pamphlet—and the author backs it up by showing how and why. He defines the word "standard" to mean a model. But, he limits it to models resulting from conscious decisions or to those used repetitively. Customs or habits are not standards according to that definition. 6 pages.

"The Role of Company Standards in Industrial Administration," by D. Reck. Reprinted from Advanced Management. Mellon Institute, 4400 Fifth Ave., Pittsburgh 13, Pa. No charge.

Instrumentation

A compilation of 74 technical papers presented before the Eighth National Instrument Conference held in Chicago. Some of the topics covered — instrumentation for production processes, process control instrumentation, instrumentation in research and development. 340 pages.

"1953 Proceedings of the Instrument Society of America." Instrument Society of America, 1319 Allegheny Ave., Pittsburgh 33, Pa. Members $5, non-members $10.

& Pamphlets

Unsolved Problems

A booklet listing problems submitted by ASTM committees. Each committee stated an engineering problem, what they knew about the problem and what they would like to know. 24 pages.

"Some Unsolved Problems." American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. No charge.

Placement Directory

A compilation of available information on over 1,000 companies employing over 5½ million people. These companies hire over 35,000 college graduates each year. The book is useful to both schools and to industry. It's broken down into four sections: company section, job classification section, geographical and a college section. 431 pages.

"College Placement Directory." 1953 Ed. by O. T. Zimmerman and Irvine Lavine. Industrial Research Service, 90 Washington St., Dover, N. H. $10.75.

Hypochlorite Specifications

A tentative specification for calcium and sodium hypochlorites used in water treatment. Includes sampling standards in addition to testing methods. 7 pages.

"Tentative Standard Specification for Hypochlorites." AWWA B300, American Water Works Assoc., Inc., 521 Fifth Ave., New York 17, N. Y. No charge.

Zein

An annotated bibliography compiled for zein—the alcohol-soluble protein from corn. Booklet consists of 942 citations coverying a wide range of topics: from composition to applications and uses. Includes period 1891 to 1953. 118 pages.

"Zein." by D. M. Rathmann. Mellon Institute of Industrial Research, 4400 Fifth Ave., Pittsburgh 13, Pa.

a fashion note styled with the help of Lebanon stainless steel Castings

To create the lasting color-beauty of fabrics woven from new synthetic fibers, these fabrics are dyed under pressure at elevated temperatures in a process employing highly corrosive acids. Gaston County Dyeing Machine Company, Stanley, N.C., uses corrosion-resistant Lebanon Circle Ⓛ Stainless Steel Castings for vital parts of their textile dyeing equipment which is in service all over the world. These Lebanon castings, produced in materials that are engineered for the service, have been found more economical than fabrications, and their outstanding corrosion-resistant properties play a major role in holding the color integrity of the lovely new fabrics.

Lebanon Steel Foundry
Lebanon, Pennsylvania

In Gaston County's dyeing machines as well as many other installations, Lebanon has been successful in filling needs with castings correct in every detail. Your inquiry will receive prompt attention.

Lebanon
Carbon, Low Alloy and Stainless Steel
Castings

The extent to which metal will corrode in atmosphere — or even whether it will corrode at all to any appreciable degree — is determined primarily by the moisture content of air. While deterioration at normal temperatures and humidities of less than 35% is so slow as to be almost negligible, the rate accelerates rapidly beyond a critical point of approximately 65%. This activity is intensified when such contaminants as hydrogen sulfide or sulfur dioxide are absorbed from industrial atmospheres. Impingement of solids, which tends to hold this acid film in contact with metal, localizes and further advances corrosive attack.

When exposure to atmosphere includes also exposure to sunlight and to the variables of weather, the situation becomes more complex. Such factors as the composition of metal and of the protective rust film that forms upon it, the length of time surfaces are wet, the extent to which they retain moisture, and whether they may be bared intermittently by heavy rainfall are influential in determining metal life.

An understanding of the mechanism of corrosion in all of its varied phases is an obvious requisite to prescribing methods of control. Thirty-five years' study and evaluation of industrial corrosion problems and the formulation of protective coatings to meet them has taught us something about corrosion and the ways in which it may be checked successfully.

We are ready to share that knowledge with you in an analysis of any metal-maintenance problem you feel requires the *different* approach of considered engineering judgment . . . to give you a recommendation you can be sure is technically correct and practically workable — for quality protective surfacing that is right for you because it is individually job-selected to meet your service specifications.

MAINTENANCE FOR METAL

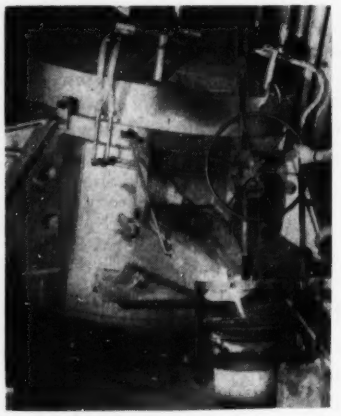
THE DAMPNEY COMPANY

160-1 HYDE PARK, BOSTON 36, MASSACHUSETTS

THIS MONTH'S

Firms in

New Facilities



Fairbanks, Morse & Co.—A modern pump plant has been erected on a 38½ acre site in Kansas City, Kan. The plant's completely mechanized foundry, with its towering cupolas, three-story core furnaces and large electric furnace is able to turn out 70 tons of castings a day. The electric arc furnace or "tilting teapot"—pictured above—can hold 11 tons of molten iron at desired temperatures and will melt 2 tons/hr. from a "cold charge."

The plant will manufacture side suction, trash, angle-flow, split-case, and steam and power reciprocating pumps.

International Petroleum Co., Ltd.—Construction is planned for a new oil refinery at Cartagena on the Caribbean coast.

British Petroleum Chemicals—A new chemical plant at Grangemouth, Scotland, is planned to make a raw material for detergents.

A. P. Moeller Co.—Erection of a $11½ million oil refinery at Copenhagen, Denmark, is planned.

International Salt Co., Inc.—A waterfront site on the Chicago River has been acquired, for a salt bagging plant and 520 ft-dock.

the News

M. A. Gibbons

Atlas Powder Co.—Establishment of warehouse facilities in Atlanta, for polyhydric alcohols.

Union Carbide & Carbon Corp.—Contract for its silicone-producing plant at Long Beach, W. Va., has been awarded to Baker & Coombs.

Babcock & Wilcox Co.—Expansion program to increase production by 40 percent has been completed in Beaver Falls, Pa.

Lone Star Sulphur Corp.—Completion of its $880,000 plant at Ft. Bend County.

Gulf Oil Corp.—A new laboratory and office building have been set up in Philadelphia.

Ferro Corp.—Purchase of the Louthan Mfg. Co. to produce electrical porcelain insulators.

Lunn Laminates, Inc.—New sales offices have been opened in New York.

Chinese Petroleum Corp.—A contract has been awarded to Fluor Corp. for a Socony-type 45 TCC unit for CPC's Taipeh refinery.

New Process Metals, Inc.—Expansion program including an enlarged plant facilities, in Newark, has been completed.

Kaiser Aluminum & Chemical Corp.—$1.5 million expansion at its Trentwood rolling mill in Wash.

H. K. Porter Co.—Has acquired the Pioneer Rubber Mills, Inc., Pittsburg, Calif.

Vacuum Oil Co.—A 1-million-ton-a-year refinery at Coryton, Essex, England, has been opened.

Container Corp. of America—Has acquired the assets of the Traver Corp.

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SOLVE YOUR SPECIAL PACKING PROBLEMS..

for **CORROSION-FREE PACKING SERVICE IN PUMPS AND VALVES....**

You can effectively handle any corrosive liquid or gas by repacking your valves and pumps with "John Crane" Chemlon "C-V" Rings. Molded from the remarkable material, Teflon, "John Crane" Chemlon "C-V" Rings are impervious to almost every known chemical substance. They withstand extreme temperatures from −94° to +482°F—have extremely low friction coefficient. "Breakout" friction is only slightly higher than that of running friction. Special cross sectional design affords positive sealing at practically finger-tight gland pressure.

To bring you all the important advantages of Teflon for your particular sealing problem or application, "John Crane" has developed a complete line of Chemlon "C-V" Rings and male and female adapters. If you have special requirements, additional sizes can be molded to fit your stuffing box dimensions.

"John Crane's" illustrated booklet "The Best in Teflon" contains extensive information on a wide variety of Chemlon Products. Send for your free copy. Crane Packing Co., 1809 Belle Plaine Ave., Chicago 13, Ill.

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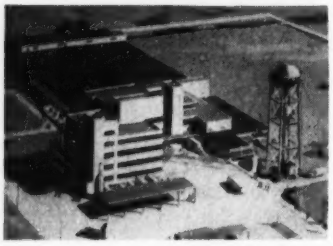
FIRMS . . .

U. S. Rubber Co.—Has constructed a new warehouse and office building in Naugatuck, Conn.

Elizalde & Co.—Plans to set up a major industrial explosives plant in the Philippines.

Gulf Refining Co.—A platforming catalytic reforming unit will be constructed at Cincinnati.



National Aniline Div.—A date, late in 1954, has been set for the completion of all facilities at the $28½-million Chesterfield Works.

R. M. Hollingshead Corp.—A new $1 million plant in Sunnydale, Calif., will produce hydraulic fluids and corrosion preventatives.

Eastman Kodak Co.—A new processing laboratory in Fair Lawn, N. J., has been opened.

Salt Lake Refining Co.—Construction contract for a catalytic cracking unit has been awarded to Fluor Corp.

Shell Chemical Corp.—Acquisition of the major assets of Lac Chemicals, Inc.

Holman Transfer Co.—Two Portland, Ore., warehouses have been opened in an expansion program.

Anderson-Prichard Oil Corp.—A new Atlantic catformer at Cyril, Okla., has been placed on stream.

Government of India—Plans to set up an ammonium nitrate plant and urea plant at Sindri, India.

Penn. Salt Mfg. Co.—Has doubled production capacity for anhydrous ferric chloride.

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High quality stainless sheet and strip steel . . . for the product you make today and the product you plan for tomorrow.

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Chemiseal Packing

- won't contaminate
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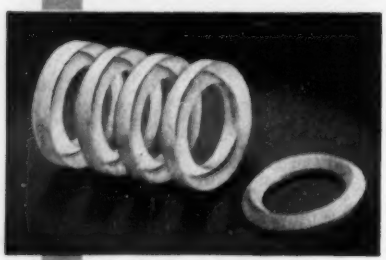
- won't "freeze" shaft action

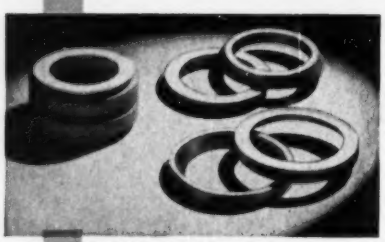


V-TYPE PACKING

Chemiseal Type 810 TEFLON V-Packing for use in manual, air or motor operated valves. Construction and distinctive tapered V design offers chemically impervious service and greater flexibility and resiliency, providing necessary seal at low gland pressure and reduced torque on valve stem.

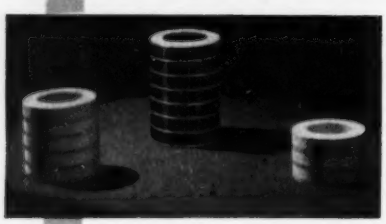
CUP AND CONE TYPE PACKING

Chemiseal Type 810-W TEFLON Packing for both hand and mechanically operated valves. Cones deform inwardly to effect a seal at the spindle, while cups expand outwardly against stuffing box wall, making possible a tight seal at low gland pressure.



WEDGE TYPE PACKING

Chemical Type 810-WX Packing offers the unusually low gland load required for valves made of Haveg, Karbate, ceramics, etc. Rings provide space for thermal expansion. Also adaptable for spring loading wherever exceptionally low friction load is required.



PUMP PACKING

Order Chemiseal Types 711-G, (graphite, impregnated) No. 711-M, (impregnated with mica) and No. 711-O (pure TEFLON). For general purpose or non-contaminating pump service throughout the processing industries.

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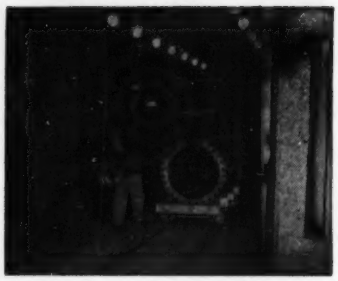

Metalweld, Inc.—Installation of a large sandblast chamber in their Scotts Lane, Phila., plant, has been completed.

Floridin Co.—New executive offices have been set up in Tallahassee, Fla.

Liquid Carbonic Corp.—A new carbon dioxide plant is planned in Houston.

Ferro Corp.—Acquisition of the assets of Peterson Kiln Co., Los Angeles.

Naph-Sol Refining Co., Muskegon, Mich.—Erection of a 1000 barrel/day Universal Oil Platformer is planned.

Ebasco Services Inc.—A Dallas office in the Southland Life Bldg.

H. Muehlstein & Co., Inc.—A new laboratory has been opened in Jersey City, featuring rubber mixing research operations.

F. J. Stokes Machine Co.—A $1 million expansion program will soon be completed.

The Foxboro Co.—A new branch factory has been erected in Dallas.

Tri-State Chemical Co.—Production has begun at its $150,000 mixed fertilizer plant at Springdale, Ark.

Continental Sulphur & Phosphate Co., Dallas—A Nevada sulfur plant will be constructed by the American Sulphur & Refining Co.

S. & W. Chemical Co., Niagara, N. Y.—A $50,000 building as a

for Pumping SULPHUR

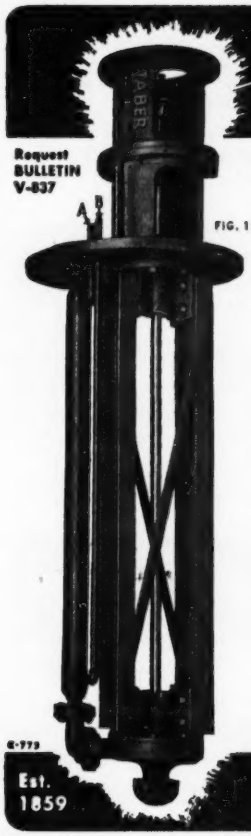

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FIG. 19.478

This TABER centrifugal, Vertical Pump was designed to handle molten sulphur. Note the massive construction. Supporting the suspended pump from channel steel permits the use of an open shaft. This is especially desirable for molten sulphur.

Steam jacketed discharge pipe keeps molten materials from solidifying.

Pump operates efficiently at the relatively slow speed of 1750 r.p.m. (We consider 3600 r.p.m. prohibitive because molten sulphur has no lubricating properties.)

Write us the Head, and gpm you wish to handle together with the depth of your sulphur pit, and we shall send further information, with BULLETIN V-837.

TABER PUMP COMPANY
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TABER PUMPS

Free... more productive capacity

Get more production from your present processing equipment. Increase capacity by eliminating space-wasting foam with Dow Corning silicone defoamers. Here are some typical examples:

- ✔ standard molasses processing load increased from 18 to 24 tons!
- ✔ yield on textile vat dyes doubled!
- ✔ in processing food, vacuum concentration capacity increased 60%!
- ✔ proposed $2,000,000 expansion of processing plant made unnecessary by efficient foam control!

Dow Corning Antifoam A Compound and Antifoam AF Emulsion are the most versatile and economical defoamers on the market. Effective at remarkably low concentrations, they pay for themselves time and again in more complete use of process equipment and shorter processing time, and in the elimination of waste and fire hazards. Both defoamers are tasteless, odorless and physiologically harmless.

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Use DOW CORNING ANTIFOAM A or DOW CORNING ANTIFOAM AF EMULSION

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Alsop Filters, Mixer and Tanks are available in a complete range of sizes and capacities and Alsop equipment is custom fitted to your particular application by engineers who have thorough experience in filtration and agitation.

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BEST SUITED TO YOUR PLANT CONDITIONS

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FIRMS . . .

part of the firm's new chemical plant at La Porte, Tex., is planned.

Johns-Manville Corp.—A new plant at Lompoc, Calif., has begun for the manufacture of synthetic silicates from crude diatomite.

Jones-Dabney Div., Devoe & Raynolds Co., Inc.—A $500,000 laboratory has been opened, in Louisville, Ky.

Annin Co.—Additional facilities for the design and manufacture of automatic control valve equipment.

Monsanto Chemical Co.—Has established a plasticizers bulk station at Greensboro, N. C.

Parke, Davis & Co.—Has set up a Johannesburg, So. Africa, branch.

Victor Chemical Works—A new plant addition in Chicago Hts. will serve as headquarters for a variety of new organo-phosphorus compounds.

Dow Chemical Co.—A new field office has been established in Cincinnati, Ohio.

Imperial Chemical Industries—Plans to open a large paint and dye factory in Egypt.

Borregaard Chemical Works, Oslo, Sweden—A sulfuric acid plant with a capacity of 22,000 tons a year has been put into operation.

Chemical Enterprises, Inc.—Has added Gulf Liquid Fertilizer Co., Wharton, Tex., as a subsidiary.

Standard Oil Co., British Columbia—Production will soon begin at the firm's new $10 million refinery near Vancouver.

4 GOOD REASONS
for specifying Watson-Stillman Forged Steel Fittings

Here's why **W-S FORGED STEEL FITTINGS** mean safe, dependable operation of your piping system:

1. They're *drop-forged* to produce the well-known forged fiber structure with exceptionally high tensile and impact strength.

2. They're "Safety-Factor" designed with heavy walls where you need them. Extra long bands extend well beyond the last thread.

3. They're precision machined. Special automatic angle indexing machines maintain precise angular accuracy for perfect alignment. Long accurate threads insure tight joints.

4. They're fully inspected. Gauges double-check the close tolerances, angularity, threads and sockets and concentricity.

WATSON-STILLMAN FORGED STEEL FITTINGS give you maximum resistance to pressure, temperature, corrosion, shock and vibration. They protect your system against costly shut-downs.

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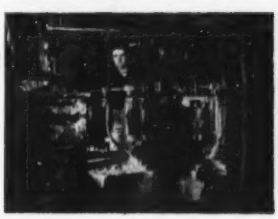
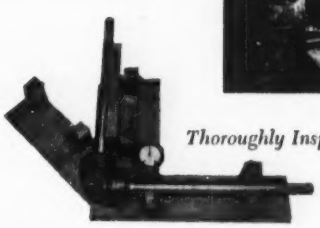
"Safety-Factor" Design



Precision Machined



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To Compare the Quality and Performance of Any CENTRIFUGAL FAN!

1 Finished Inlets and Outlets Ready for Duct Connections.

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Bayley BLOWER COMPANY

Engineered Air-Handling Equipment

1823 S. 66th St. Milwaukee 14, Wis.

FIRMS . . .

Rockwell Mfg. Co.—Operations have begun at the firm's Texas plant, in Sulphur Springs.

Trane Co.—A research laboratory has been opened in LaCrosse, Wis.

Timken Co.—Six new furnaces have been installed at the firm's Bucyrus plant.

Penn. State Univ.—Contract to provide control instrumentation for the school's research nuclear reactor has been awarded to Leeds & Northrup Co.

International Paper Co.—Has acquired the stock of American Paper Exports, Inc.

Sharp & Dohme—Construction of a new Chicago branch office has been completed.

Upjohn, Inc.—A $200,000 warehouse and sales office is being constructed in Denver.

New Representatives

Ampco Metal, Inc., Milwaukee, has chosen the Aweco Supply Co., Tucson, as distributor for its line of weldrod products for southern Ariz.

Parker Appliance Co., Cleveland, has selected Standard Products, Inc., and Power Transmission Products, Portland, Ore., as representatives.

American Alcolac Corp., Baltimore, has named the Wasatch Chemical Co., Salt Lake City, as distributor of industrial chemicals.

Morse Chain Co., Detroit, Mich., has named Service Power Transmission Co., Fair Lawn, N. J.;

LOOK BEFORE YOU BUY

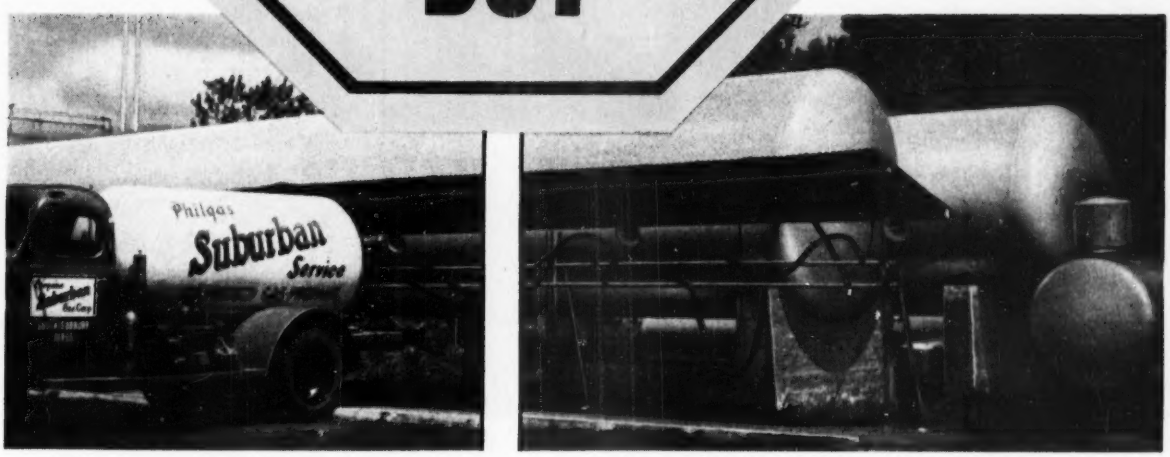

PHOTO COURTESY SUBURBAN PROPANE GAS CORPORATION

Few manufacturers have the skill or the means to put ACF quality in tanks...yet prices are identical. That's why it pays to look before you buy!

When you're in the market for storage tanks for propane or anhydrous ammonia, or any pressure gas this difference in quality pays tremendous dividends...in service, in low maintenance, in extra safety.

ACF manufacture not only x-ray inspects every inch of welded seam, but completely stress relieves the finished tank (to banish stresses set up by welding). Few other manufacturers have the facilities to do this.

Look before you buy, get unmatched value, yet pay no more. An ACF Representative will be glad to explain the details. Literature is available on ACF Storage Tanks and all types of Safety Valves. Write ACF Industries, Incorporated, New York · Chicago · St. Louis · Cleveland · Washington · Philadelphia · San Francisco

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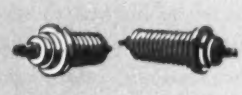
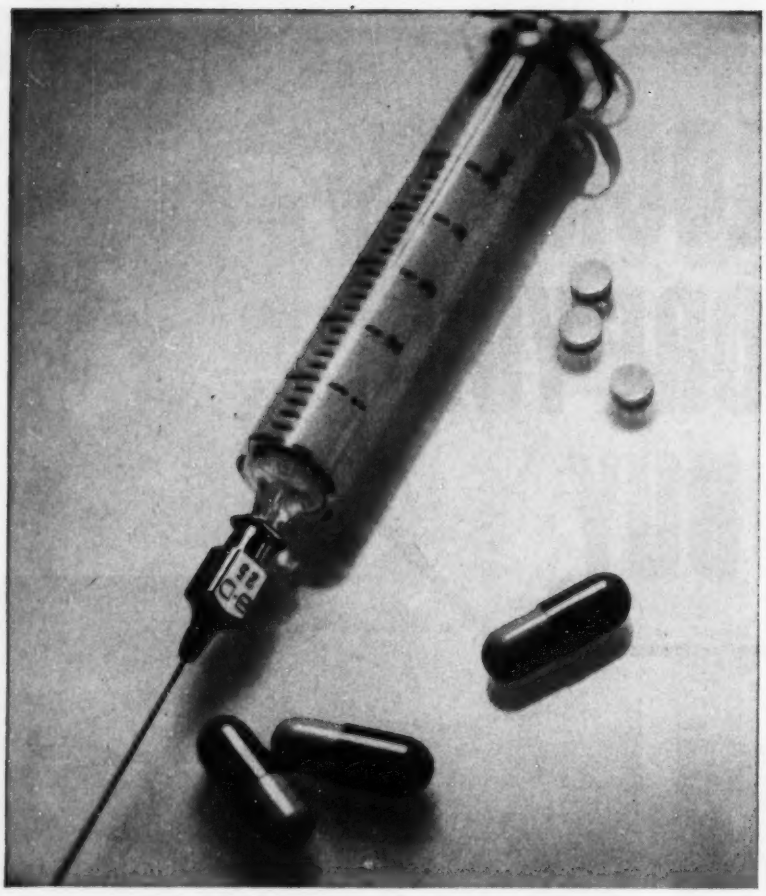


STORAGE TANKS · TRUCK TANKS · SAFETY VALVES



so pure it's used to filter the "wonder drugs"

SOLKA-FLOC®

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SOLKA-FLOC guarantees a clear, pure filtrate. Its finely-divided cellulose particles mesh and bond to form the perfect filter barrier. That's just one of many reasons why producers of antibiotics use SOLKA-FLOC as a filter aid.

It can be handled readily with a knife, will not gouge . . . gives a more stable cake, will not bleed . . . gives longer life to the precoat . . . is chemically inert, easily washable . . . can be burned to recover any valuable solids remaining.

SOLKA-FLOC offers you a wide range of grades, enabling you to obtain any desired combination of flow rates and efficiency of filtration. Whatever you filter, it may be just what you need to solve your filter problems.

Write to our Technical Service Department *DF-8*, in Boston, describing your problem in detail.

BROWN COMPANY, Berlin, New Hampshire
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General Sales Offices:
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Dominion Square Building, Montreal, Quebec

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FIRMS . . .

and Navarro Supply Co., Pecos, Tex., as distributors.

Arapahoe Chemicals, Inc., Boulder, Colo., has appointed Tracerlab, Inc., Boston, as exclusive distributors of all Arapahoe compounds for liquid scintillation counting.

Atomic Instrument Co., Cambridge, Mass., has appointed the Engineered Products Div., Straus-Frank Co., as sales representative.

Monsanto Chemical Co., has named Barada & Page, Inc., St. Louis, to handle all sales of liquid chlorine in cylinder quantities.

Orr & Sembower, Inc., Reading, Pa., has appointed Ogle Eng. Sales, Louisville, Ky., as sales and service representative.

Uniform Tubes, Inc., Collegeville, Pa. has selected David C. Clem, Phila., Pa., as representative for Maryland and Delaware.

The American Car & Foundry Co., N. Y., has appointed Shippers' Car Line Corp., as its exclusive sales representative.

Morehouse Industries has selected the M. B. Sweet Co., Chicago, to serve as sales and service representative.

Mercury Mfg. Co., Chicago, has named the McKinley Equipment Co. as its representative in Los Angeles.

New Companies

National Lead Co. (Philippines)—To produce mixed paints in Manila, under the "Dutch Boy" trade-mark.

No. American Asbestos Corp.—First U. S. subsidiary of the Cape Asbestos Co., Ltd., London, will serve U. S. consumers of raw and processed asbestos from Cape's So. African mines.

American Minerals & Chemicals Corp.—The result of the merger

JENKINS PRACTICAL PIPING LAYOUTS 73

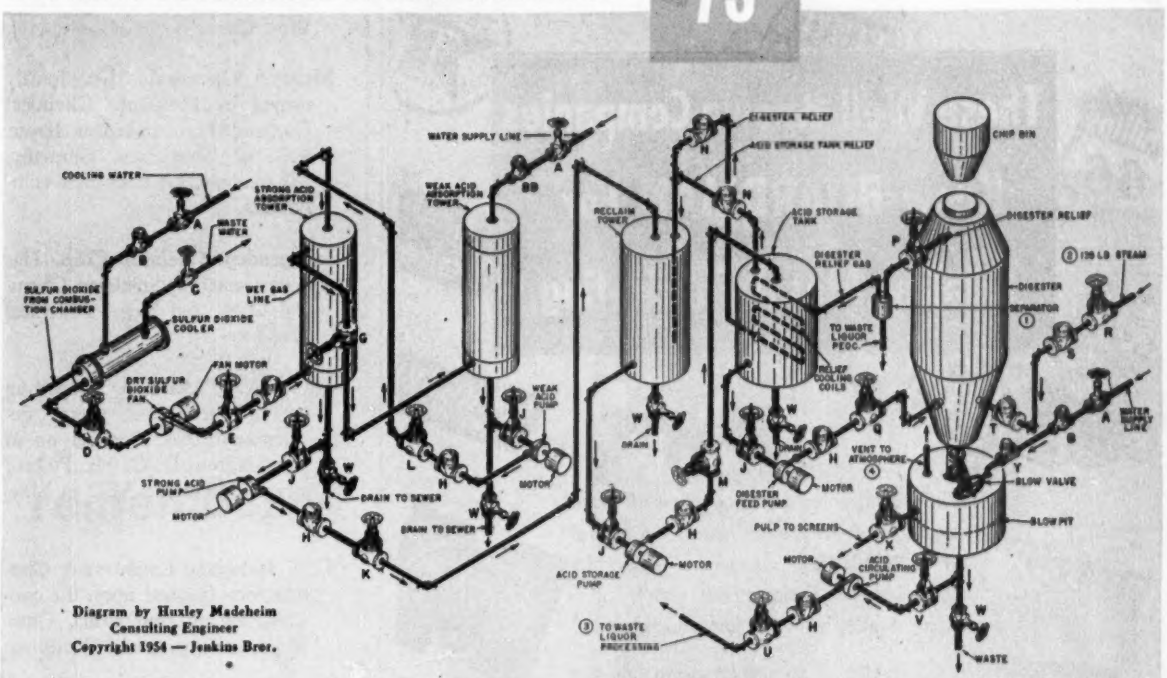

Diagram by Huxley Madeheim
Consulting Engineer
Copyright 1954 — Jenkins Bros.

VALVE RECOMMENDATIONS
For details of Jenkins Stainless Steel Valves, write for Bulletin 200.

Code	Quan.	JENKINS VALVE	SERVICE
A	3	Fig. 106-A, Bronze Globe	Water supply control
B	2	Fig. 352, Bronze Swing Check	Water line secondary check
BB	1	Fig. 1328, Stainless Steel Swing Check	Water line check
C	1	Fig. 47-U, Bronze Gate	Cooler water shutoff
D	1	Fig. 613, I.B.B.M. Globe	Sulfur dioxide fan control
E	1	Fig. 651-A, I.B.B.M. Gate	Gas shutoff
F	1	Fig. 1331, Stainless Steel Swing Check	Prevent strong acid backflow to SO_2 fan
G	1	Fig. 1307-A, Stainless Steel Gate	Gas shutoff
H	8	Fig. 1331, Stainless Steel Swing Check	Prevent backflow to pump
J	4	Fig. 1307-A, Stainless Steel Gate	Pump suction shutoff
K	1	Fig. 1317, Stainless Steel Globe	Strong acid pump discharge control
L	1	Fig. 1317, Stainless Steel Globe	Weak acid pump discharge control
M	1	Fig. 1317, Stainless Steel Globe	Acid storage pump discharge control
N	2	Fig. 1331, Stainless Steel Swing Check	Prevent gas backflow
P	1	Fig. 1307-A, Stainless Steel Gate	Digester relief control
Q	1	Fig. 1317, Stainless Steel Globe	Digester feed pump discharge control
R	1	Fig. 1040, Cast Steel Globe	Steam control valve
S	1	Fig. 1025, Cast Steel Swing Check	Steam line secondary check
T	1	Fig. 1331, Stainless Steel Swing Check	Prevent acid backflow
U	1	Fig. 1317, Stainless Steel Globe	Acid circulation pump discharge control
V	1	Fig. 1307-A, Stainless Steel Gate	Circulating pump shutoff
W	8	Fig. 1309, Stainless Steel Globe	Drain control
X	1	Fig. 1317, Stainless Steel Globe	Pulp discharge control
Y	1	Fig. 1328, Stainless Steel Swing Check	Prevent acid backflow

How to plan PIPING FOR ACID LIQUOR PREPARATION IN THE SULFITE PULPING PROCESS

The sulfite pulping process calls for a digester solution that is strongly acid. It is prepared by burning sulfur or pyrites to form sulfur dioxide, which is passed through absorption towers containing limestone and water. This produces an acid liquor consisting mainly of calcium bisulfite and sulfurous acid. The wood chips are cooked with this acid liquor at approximately 300°F, by steam admitted as indicated in the diagram.

Pressure is reduced by opening the digester relief valve when cooking is completed. The hot gases pass through the coils in the acid storage tank to preheat the liquor, then back to the reclaim tower where they go into solution. Next, the liquor and pulp are forced into the blow pit by the pressure remaining in the digester. The liquor is drained off and sent to waste, or is processed for by-products. Water, free of impurities which might contaminate the pulp, is then admitted to wash the pulp thoroughly. After this washing, the pulp passes onto screens and eventually to the paper making process.

Valves controlling the dry sulfur dioxide gas (prior to passing through an absorption tower) are iron body bronze mounted. Valves specified for the wet sulfur dioxide gas (after passing through an absorption tower) are stainless steel, because of the corrosive nature of the acid bearing gas. Valves in the liquor lines are Stainless Steel, Type 316, due to the corrosive combination of calcium bisulfite and sulfurous acid. Valves for water and steam lines are bronze, with the exception of the check valves marked "S" and "Y", which are stainless steel due to the possibility of acid liquor or gas backing up.

Consultation with accredited piping engineers and contractors is recommended when planning any piping installation.

To simplify planning, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17.

Complete description and enlarged diagram of this layout free on request. Includes additional detailed information.

JENKINS VALVES
LOOK FOR THE JENKINS DIAMOND
Jenkins Bros.
SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS EVERYWHERE

These Well-Known Companies
Know BOARDMAN For
Quality Metal Fabricating
When companies of the calibre of those named here—representing only a partial list of BOARDMAN customers—select the same firm for their varied metal fabricating needs, it means just one thing:
In the quality of its workmanship and the character of its service, BOARDMAN delivers the goods!
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With absolutely no obligation on your part, our Chief Engineer will fly to your plant for on-the-spot consultation regarding your particular metal fabrication problems. For literature, quotations or immediate action, write, wire or telephone TODAY.
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METAL FABRICATING SPECIALISTS FOR MORE THAN 40 YEARS
PRESSURE VESSELS INCLUDING A.S.M.E. CODE VESSELS • BATCHERS • BINS • BURNERS
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GRADING EQUIPMENT • HOPPERS • MIXERS • STACKS • STERILIZERS • TANKS • WASHERS

FIRMS . . .

of the Attapulgus Minerals & Chemicals Corp. and the Edgar Bros. Co.

Mobay Chemical Co.—Jointly owned by Monsanto Chemical Co. and Farbenfabriken Bayer, A.G. of Leverkusen, Germany, will manufacture isocyanate compounds.

Independent Chemical Corp.—Has been formed by Spielman Chemical Corp. and Siegel Chemical Co., Inc.

James K. Pickard—A consulting practice in atomic energy developments has been set up in Washington, D. C. Mr. Pickard resigned from the AEC in May, 1954.

U. S. Industrial Engineers & Constructors—Formed upon the consolidation of four firms. Combined resources total $5½ million.

Tuloma Gas Products Co.—Formed as a subsidiary of Standard Oil Co. (Indiana) to sell liquefied petroleum gas on a nation-wide basis.

New Names

W-K-M Co. has become a subsidiary of ACF Industries, Inc. and will be known as W-K-M Mfg. Co., Inc.

Precision Machine Co. has changed its name to Precision Chemical Pump Corp.

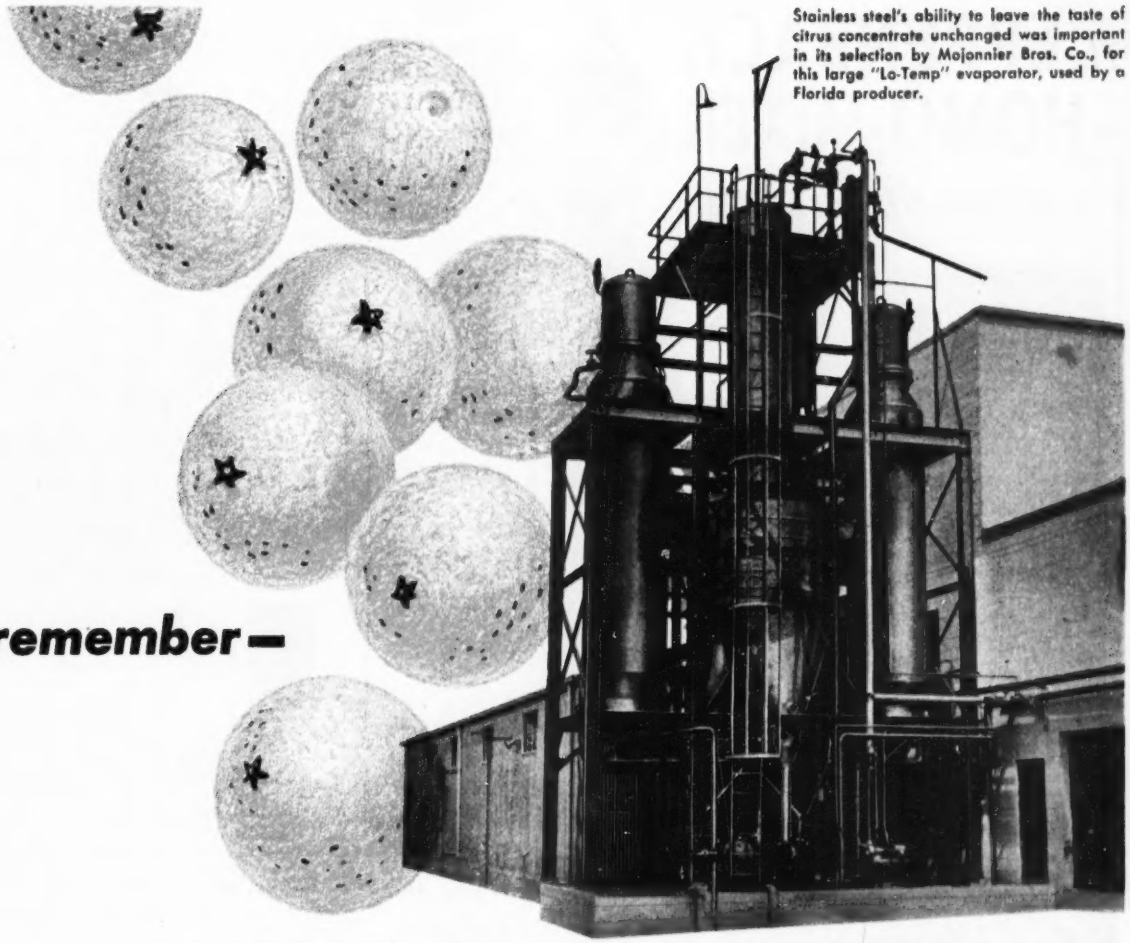
Hamer Oil Tool Co. has changed its corporate name to Hamer Valves, Inc.

"**Enthol**" is the new name for Enthone, Inc.'s Enthone Compound 42.

New Lines

U. S. Steel Corp.—Will commence production of plastic pipe at the Nat'l Tube Div.

American Cyanamid Co.—Has added Calco Soluble Vat Brown BY to its line of leuco ester color dyes.



Stainless steel's ability to leave the taste of citrus concentrate unchanged was important in its selection by Mojonnier Bros. Co., for this large "Lo-Temp" evaporator, used by a Florida producer.

remember—

Stainless Steel is VERSATILE, too

FREE—44-page book, "Making the Most of Stainless Steels in the Chemical Process Industry." Gives you helpful hints on the design, use and care of chemical equipment of stainless steel.

Stainless steel has been a standard material in the chemical industry for many years — yet its great versatility is sometimes overlooked. For example, though there are thousands of corrosive or sensitive media in the chemical field, it is rare indeed not to find a specific grade of Crucible Resistal® stainless steel either to resist corrosion satisfactorily, or to prevent contamination of the product.

Physical properties of stainless grades cover a broad range, also. Stronger than ordinary carbon steel, stainless equipment is substantially lighter. At the same time, stainless equipment withstands attack both at high and low temperatures. Abrasion resistance of stainless is remarkably high, too, as is its fatigue strength. That's why moving parts of stainless steel will give unusually long service, even under severe vibrational stress. Finally, stainless is an *excellent shop metal* — it can be readily fabricated into any process equipment, no matter how complex.

So the next time you need process equipment — look first to Crucible stainless for the most practical, most economical material. And for special suggestions on how best to apply stainless in your plant — *call Crucible.*

CRUCIBLE first name in special purpose steels

54 years of Fine steelmaking **STAINLESS STEELS**

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

REX HIGH SPEED • TOOL • REZISTAL STAINLESS • MAX-EL • ALLOY • SPECIAL PURPOSE STEELS

Canadian Distributor — Railway & Power Engineering Corp., Ltd.

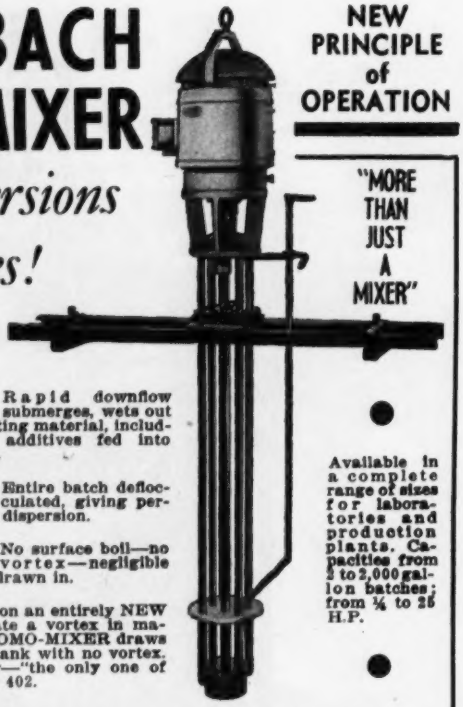
The EPPENBACH -HOMO-MIXER-

NEW PRINCIPLE of OPERATION

"MORE THAN JUST A MIXER"

1 makes dispersions

2 homogenizes!



1. Turbine head near tank-bottom causes converging horizontal flow, carrying sedimentary material into close-fitting rotor vanes.

2. Inflowing "slurry" violently agitated at high velocity, projected up toward surface.

3. Submerged baffle plate deflects rising current toward tank sides, thence down toward bottom.

4. Rapid downflow submerges, wets out floating material, including additives fed into mix.

5. Entire batch deflocculated, giving perfect dispersion.

6. No surface boil—no vortex—negligible air drawn in.

This mixer is built and operates on an entirely NEW principle. Ordinary mixers create a vortex in material, pull air into tank. The HOMO-MIXER draws only from the BOTTOM of the tank with no vortex. Write for details of this mixer—"the only one of its kind". Ask for Catalog No. 402.

Available in a complete range of sizes for laboratories and production plants. Capacities from 2 to 2,000 gallon batches; from ¼ to 25 H.P.

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PROPELLERS

for MIXING, STIRRING, AERATING, PUMPING, etc.

Manufactured by an exclusive process, MICHIGAN propellers are perfectly balanced to avoid whip and strain on shafts. And because of their superior functioning are now standard parts of the products of many leading equipment manufacturers.

MODEL GDA - MIXER BY INTERNATIONAL ENGINEERING DAYTON, OHIO

Available for special application and replacement, as well as original equipment, in a wide variety of metals and in sizes up to 60". Write for latest data folder.

MICHIGAN WHEEL CO.

GRAND RAPIDS 3, MICH.

If you handle bulk materials you'll want this new

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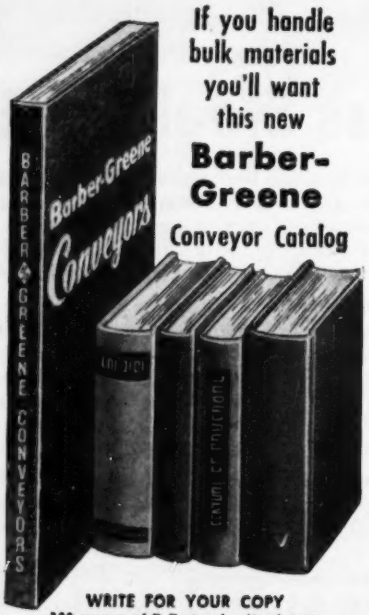
Conveyor Catalog



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192 pages of B-G standardized components, accessories, typical conveyor layouts and installation photographs. Complete, comprehensive, easy-to-use. Please request catalog 76-A on your company letterhead.

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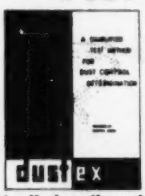
AURORA, ILLINOIS, U.S.A.

THE SHORTEST DISTANCE TO THE SOLUTION OF YOUR DUST PROBLEM



Here is the straight-line approach to facts on how to determine the solution to your dust problem. Our new manual, "A Simplified Test Method for Dust Control Determination" describes the most direct method for determining the scope of your dust problem and your dust control equipment requirements. Whether yours is a problem of recovering valuable process dust or elimination of dust that is hazardous or a nuisance —you'll profit from the time spent going over this manual.

For your copy, just clip this ad to your company letterhead and sign your name and title.

dustex CORP.

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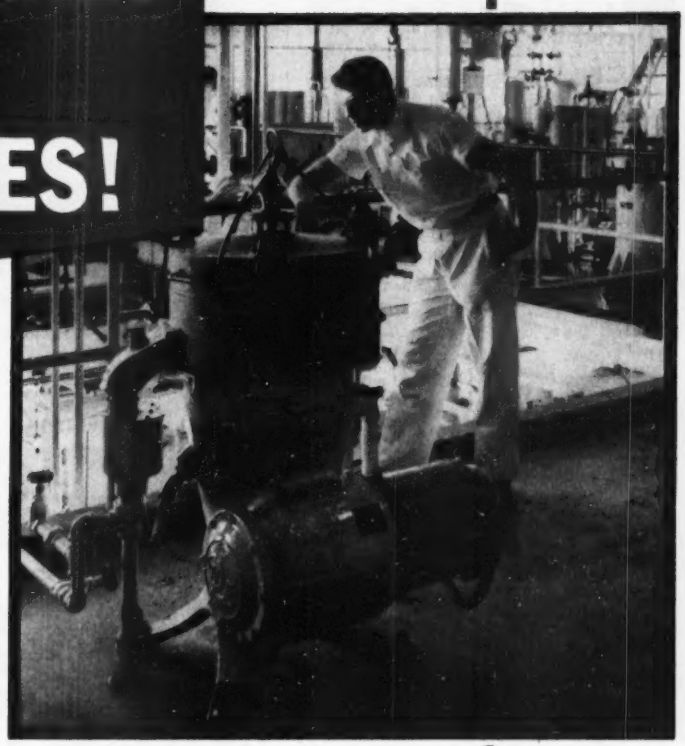

In many of America's most progressive chemical, pharmaceutical and food processing plants De Laval Separators and Clarifiers have proved to be a sound investment. So sound, in fact, that the centrifugals pay for themselves.

De Laval Centrifugals introduce the economy of *continuous* separation into processes formerly slowed down by batch separation with filters or settling tanks. In many cases they not only cut costs, but also improve the product.

If *your* processing involves liquid-liquid, liquid-solid or liquid-solid-liquid separation, investigate doing the job the *De Laval* way.

De Laval Engineers will be glad to put their wealth of experience at your service. They have shown many other manufacturers how to save money. Let them do the same for *you*.

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FOR FASTER PROCESSING SYSTEMS

More Accurate Level Reading of LOW TEMPERATURE LIQUIDS . . .

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Large Chamber

NON-FROSTING* GAGES

YOU get the highest possible accuracy of reading on low temperature, low boiling point liquids with the patented Jerguson Non-Frosting Gage in the New Large Chamber model . . . because it insures less turbulence at the meniscus, and clear vision at the vision slot.

This new Jerguson model has 6 times larger area at the meniscus than the standard gage, so that there is a marked reduction in turbulence with light gaseous fluids that tend to boil or surge. Moreover, the problem of frosting encountered with these liquids has been eliminated by a patented frost preventing unit extending from the gage glass. This special transparent unit projects beyond the cover bolts and prevents frost from building up over the vision slot.

Here's a dual feature gage that assures greatly increased accuracy of reading for the process industries. If you have a problem with light gaseous fluids, or with gage frosting, it will pay you to investigate the new Jerguson Large Chamber Non-Frosting Gage . . . reflex or transparent.

Jerguson Large Chamber Gage, Transparent Type, with the patented Non-Frosting Gage Glass Extension. Write for literature on this gage, and on other non-frosting Jerguson models.

*Patented

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Gages and Valves for the Observation of Liquids and Levels

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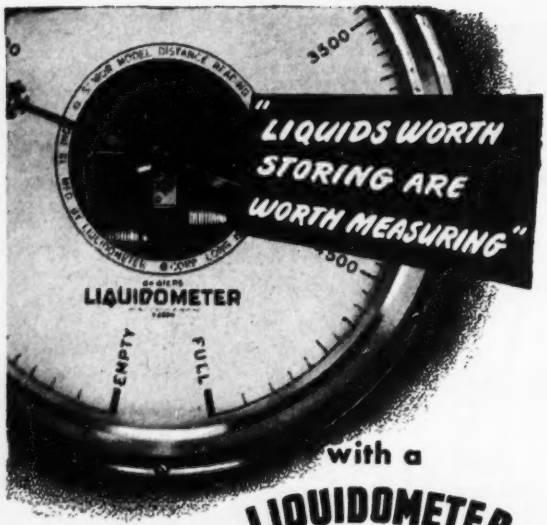

with a **LIQUIDOMETER** *Tank Gauge*

- FOR GAUGING LIQUIDS OF ALL KINDS
- 100% AUTOMATIC
- APPROVED BY UNDERWRITERS' LABORATORIES

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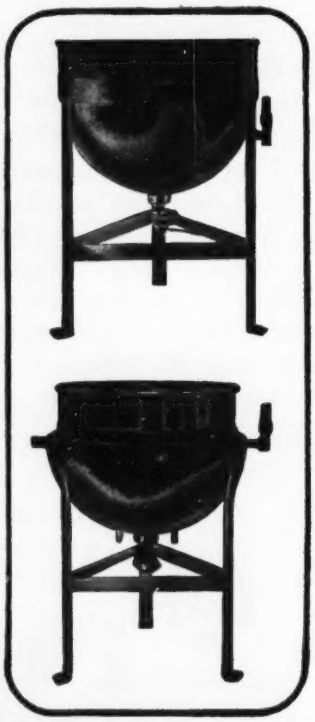
CORROSION-RESISTANT KETTLES

Lee Kettles meet every processing need. They are practical, easy to clean and keep clean, meet all sanitary regulations and are available in sizes up to 500 gallon capacity.

For longer service and greater all-around dependability, specify LEE *Corrosion-Resistant Kettles.*

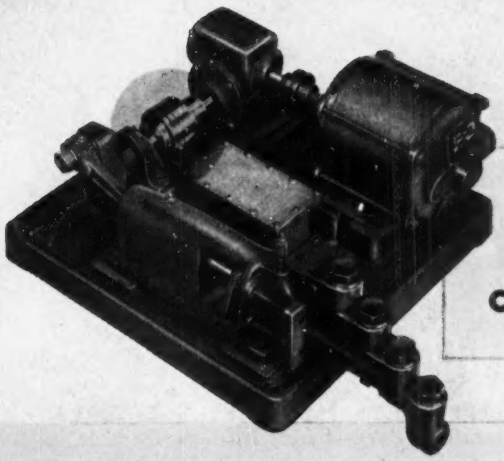
Our descriptive technical bulletins sent on request.



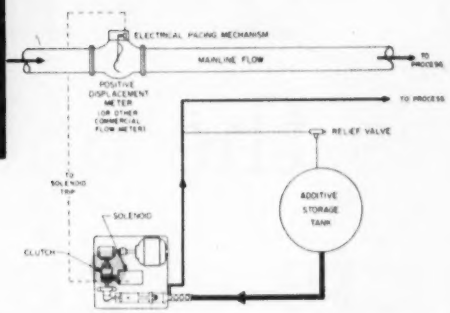
LEE METAL PRODUCTS CO., INC.
417 PINE STREET, PHILIPSBURG, PA.

ALL LEE KETTLES ARE MADE TO A.S.M.E. CODE

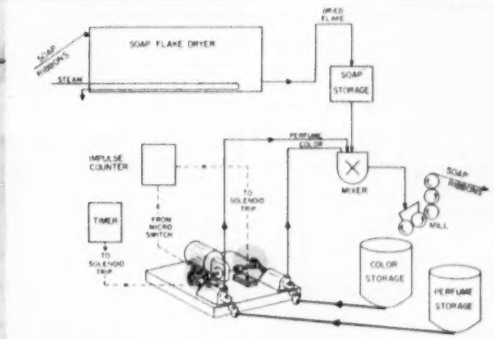
CONTROLLED VOLUME PUMPS ARE FLOW-CONTROL INSTRUMENTS



Positive displacement meter supplies signals proportional to main line flow causing Clutch-Actuated Pump to feed additive in exact ratio.



Latest Proportional Feed Techniques Use New Milton Roy Clutch-Actuated Flow Control Pumps



In simplified blending system, timer signal engages clutch to start stroke in first pump cylinder. Second clutch is actuated in proper ratio and total number of strokes is determined by Micro-switch and impulse counter.

• Accurate proportional feed . . . lower equipment costs . . . simpler installation . . . dependable operation . . . ALL are features of the newest Milton Roy development in flow control.

Designed primarily for process applications requiring inexpensive proportional feed, a Milton Roy Controlled Volume Pump and its constant speed motor are linked by a mechanical clutch in a single, compact assembly. Normally disengaged, the clutch is tripped by a solenoid upon electrical signal. The pump is then engaged for one complete suction-discharge cycle, and returned to its idling position while the motor continues to operate. Actuating signals may be supplied by a positive displacement meter or other flow meter for accurate proportional feed . . . by timer or other device where single stroke control is required. (See diagrams.)

Typical of the widespread applications of the new Clutch-Actuated Flow Control Pumps are the hundreds now in service in the Petroleum Industry's gasoline additive program. At pipeline distribution points these units are used to feed the additives in proportion to the gasoline flow. Pumps of high accuracy and rugged dependability are essential to the successful handling of these expensive additives.

Available in a wide range of models, capacities, and pressures, Milton Roy Clutch-Actuated Pumps are described fully in Bulletin 654. Write for a copy today.

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Manufacturing Engineers 1322 E. MERMAID LANE • PHILA. 18, PA.

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Ansul

is the only dry chemical fire extinguisher backed by a five year warranty!

Here is proof of Ansul's superiority . . . *a five year equipment warranty*, the only one of its kind in the fire control industry.

For the buyer of fire equipment this important warranty means many *extra* years of trouble-free protection plus freedom from costly and frequent maintenance checks and repairs.

The special design and construction features that make this warranty possible provide not only dependable protection but also *fast, effective* fire control. Ansul's *weather-tight* construction keeps out moisture and resists corrosion. *Patented nozzles* deliver the right kind of stream for your fire protection problem. The *sealed pressure cartridge* puts Ansul's "Plus Fifty" dry chemical to work immediately—no delay or lag. And finally *rugged construction* makes it possible for Ansul equipment to give peak performance under the toughest operating conditions.

HERE IS THE BIG TRAINING AND SERVICE PLUS OFFERED ONLY BY ANSUL!
Available without cost to all Ansul users.

Training for your personnel at your plant by Ansul specialists.

Customer training school at Marinette for your key safety personnel.

Visual aids on fire control for your safety meetings and other training.

In-plant survey to scientifically determine your fire protection needs.

Call the Ansul Man!

ANSUL

Get in touch with your local Ansul man through the "yellow pages" or write ANSUL CHEMICAL COMPANY, Fire Equipment Div., Dept. F-113, Marinette, Wisconsin.

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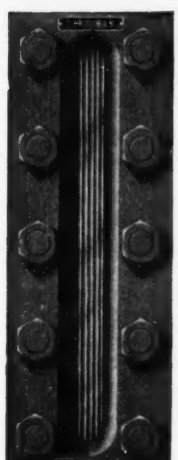

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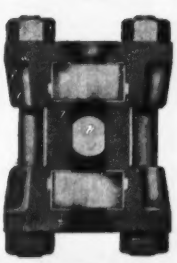

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FUMES AND VAPORS MADE SAFE WITH

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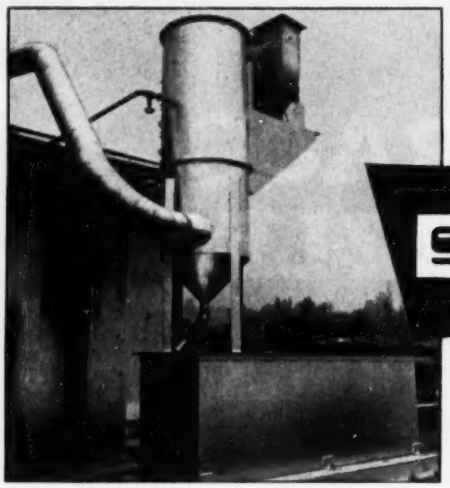

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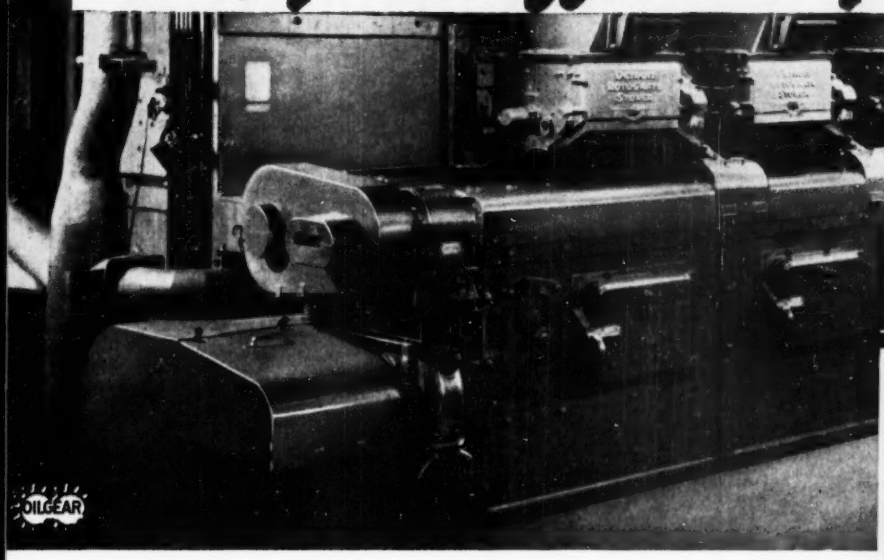
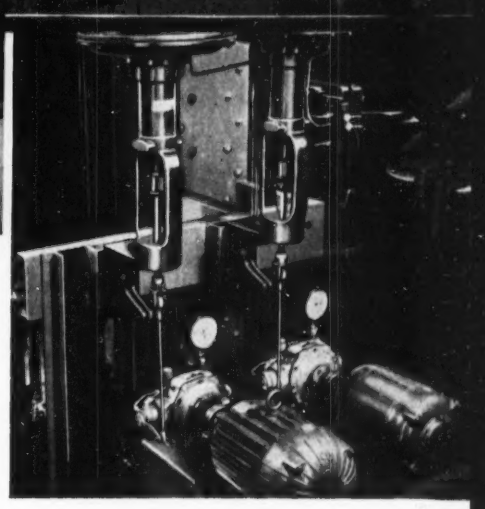


View in J. I. Case Co. tractor works at Racine, Wis. Boiler front and Detroit Roto-Grate Stoker on 100,000 lb. per hr. boiler unit.



Two Oilgear Variable Delivery Pumps with simple diaphragm actuated hydraulic servomotor lever controls supply fluid power for the fuel feed and grate drives. An Oilgear drive was experimentally installed on the fuel feed on the first stoker in 1948. On the basis of its performance, Oilgear drives were used for *both* fuel feed and traveling grate on a second stoker unit installed in 1949. Also, Oilgear will replace the mechanical grate drive on the first stoker installed in 1943. Like a shadow, flexible, controllable Oilgear *Fluid* Power causes fuel feed rate and grate speed to accompany steam demand up and down. Recording charts show steam *demand* varies "all over the place," but steam pressure and fuel air ratio stay steady.

And Oilgear's Range and Control help capture savings hidden in J. I. Case 100,000 lb. Boiler Unit

The 100,000 lb. per hour boiler unit in the J. I. Case Co. tractor works at Racine, Wisconsin, has demonstrated that it is one of the highest efficiency units in the United States. To obtain such high efficiency, careful tests of variable speed drives for fuel feed and grate travel were made during two years. Finally, Case engineers selected Oilgear Fluid Power Drives, for, as Mr. Cole H. Morrow, Chief Plant Engineer says, the Oilgear units proved far superior to electric drives and mechanical transmissions under actual operating conditions.

SMOOTH, POSITIVE SPEED VARIATION "In order to obtain high efficiency in any boiler unit," says Mr. Morrow, "*a very precise variable speed fuel feed drive* is required to meet widely varying demand. The Oilgear Drive gives smooth, positive variable speed operation from zero to 100% of capacity with a straight line fuel feed characteristic. This allows us to calibrate the control system for operation within amazingly close limits of fuel-air ratio variation.

EASE OF CONTROL "Also, on this type of stoker the grate speed must be infinitely variable from minimum to maximum yet maintained in direct proportion to the rate of fuel feed. Every change in fuel feed requires an immediate and directly proportionate change in grate speed. (Such synchronization) is easily obtained with the Oilgear drive units because of their ease of control, and the simplicity and low force requirements of the control mechanism."

UNLIMITED SPEED RANGE Also, fuel feed and grate drives must have a range of speed at least equal to the demand range. Most drives have a range not exceeding 4 to one. Yet at Racine, during the summer, demand drops far below the 25,000 lb. threshold imposed by such a ratio. The Oilgear Drives however have no "ratio" limits, would function down to zero load if necessary. In fact, they give precise load control down to a load of 15,000 pounds per hour normally obtained each day during the summer, and down to as low as 5,000 pph over the weekends still under full automatic control.

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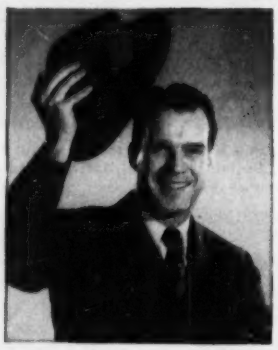

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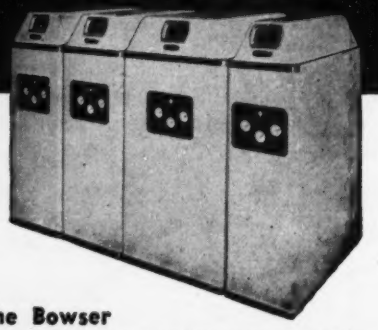

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CHECK IN-PLANT SERVICING

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EXAMPLE

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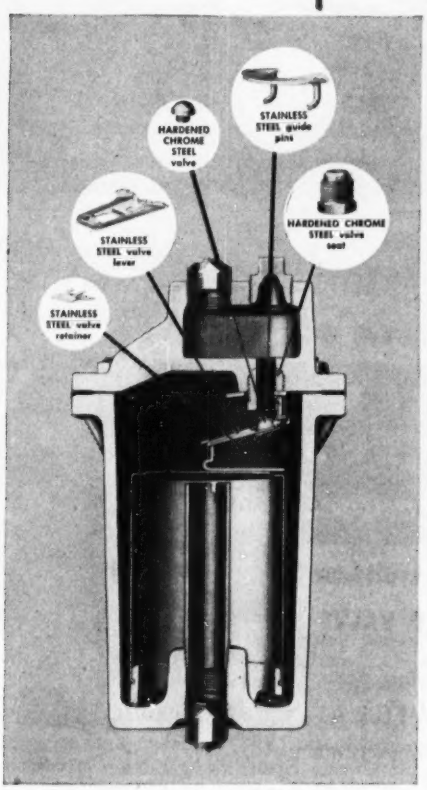
WITH GROUP TRAPPING (5 steam traps for 10 coils)	**225°F**
WITH BLOW-THROUGH (no steam traps)	**250°F**
WITH ARMSTRONG UNIT TRAPPING (10 traps—one on each of 10 coils)	**309°F**


HARDENED CHROME STEEL valve
STAINLESS STEEL guide pins
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HARDENED CHROME STEEL valve seat
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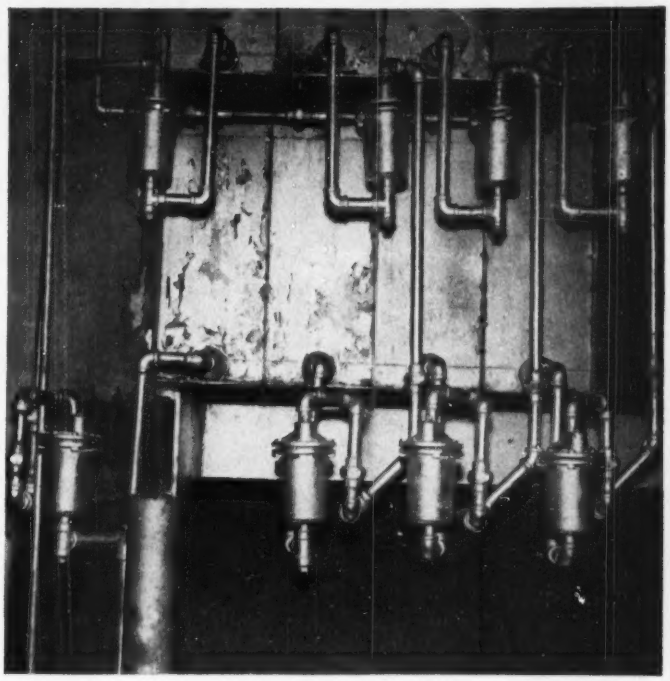
One of the big advantages of Armstrong traps is LOW MAINTENANCE. Mechanisms in low and medium pressure traps identical in design, workmanship and materials to those in 900°F, 900 psig traps.



● The example at the upper left is simply one of thousands that bear out the benefits of "Armstrong *Unit* Trapping".

When you analyze it, the reason is quite obvious. No two steam coils, chests, chambers or machines will condense steam at exactly the same rate under operating conditions. There is a greater pressure drop in the units that condense the fastest. Steam will backflow through a common drain line from a higher pressure unit to a lower pressure unit. This blocks off flow of air and retards condensate flow from the lower pressure unit. On the other hand, if you separate each unit with its own trap, that can't happen.

You will *always* get higher temperatures and lower production costs with unit trapping. Ask your Armstrong Representative about it, or write:

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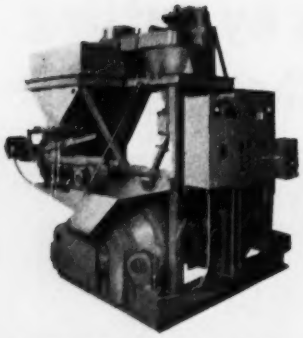
If you don't have a copy of the 44-page Armstrong Steam Trap Book, we'll be glad to send you one. No obligation.

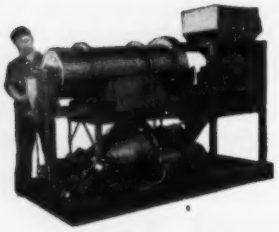
ARMSTRONG STEAM TRAPS



DRY GRINDING UNIT

Make power connections only and the Hardinge Dry Grinding Unit is ready to perform. Self-contained and portable, 7'8" high. Complete with Constant Weight Feeder, Conical Mill, "Gyrotor" Air Classifier, dust collector, product collector and "Electric Ear" grinding control.

"Packaged Pulverizers"



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Make power and water connections only and the Hardinge wet grinding unit is ready to perform. Self-contained and portable, 6½' high. Includes Conical Mill, Counter-Current Classifier, launders, feeder, pump, and "Electric Ear" grinding control.

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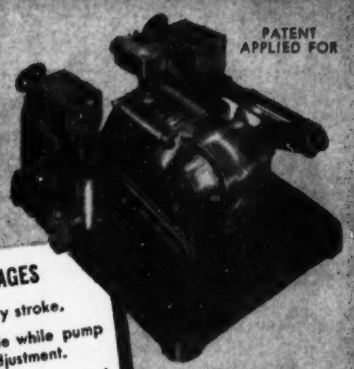

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2. Variable delivery—stroke readily adjustable while pump is running. Locking nut maintains stroke adjustment.
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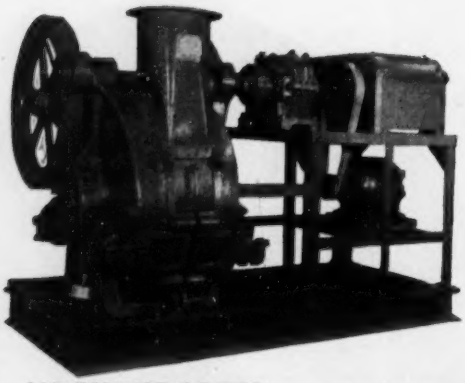

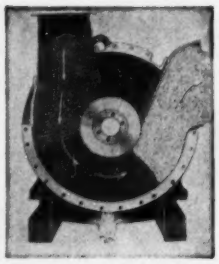

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PHOSPHORUS PENTASULFIDE	POTASSIUM CHLORATE
PHOSPHORUS SESQUISULPHIDE	POTASSIUM PERCHLORATE
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PRECISION INSTRUMENTS FOR EVERY INDUSTRY

CHEMICAL PROCESS NEWS

PUBLISHED BY CHEMICAL PROCESS DIVISION, THE M. W. KELLOGG COMPANY AUGUST 1954

NOTES ON SYNTHOL

Synthol is the name of the Kellogg-developed process for catalytically reacting synthesis gas (carbon monoxide and hydrogen) to produce a wide variety of hydrocarbon materials and chemicals. Synthesis gas for the process can be derived from either natural gas or coal.

* * *

The first plant to utilize Synthol on a commercial scale is now under construction by Kellogg in South Africa. Partial combustion of coal (from vast deposits near the plant site) will form the source of the synthesis gas; primary products of the plant will be "petroleum" fuels—around 60 million gallons per year, of which the major part will be motor gasoline.

* * *

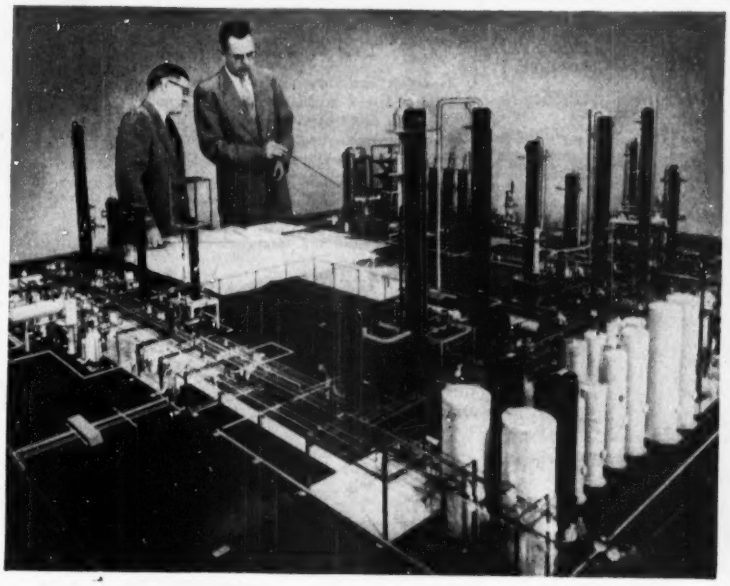
In addition to gasoline and fuel oil, the plant's output will include an impressive quantity of industrial and agricultural chemicals—about 125 million pounds. Many of these are oxygenated compounds, produced as by-products in the Synthol unit. While their volume is small in comparison with the enormous amounts of fuels produced, the higher market value of these chemicals adds substantially to the over-all attractiveness of the Synthol process.

* * *

The water-soluble or chemical stream from the Synthol unit is passed through a series of operations involving both extractive and conventional distillation to separate methanol, anhydrous ethanol, methyl ethyl ketone, and acetone. The methanol will be used as a solvent in the process and the ethanol will be blended into the gasoline pool. The other two chemicals will be marketed.

* * *

Additional equipment is being installed to produce commercial grade propanol and/or butanol, or to further process these products as additional gasoline.



Low Production Costs, High Yields and Flexible Operation Characterize New Phenol-from-Cumene Process

Shown above is a detailed model of a unique chemical plant Kellogg is currently building for Hercules Powder Company at Gibbstown, N. J. The plant will produce phenol, acetone, and methyl styrene, using the Hercules-Distillers process for oxidizing and splitting cumene. Kellogg, which developed the mechanical design of the commercial process in collaboration with Hercules, is also the originator of the process to be used for making the cumene feed.

The over-all process offers an unusual example of how refinery products can be upgraded to industrial chemicals to obtain a radical increase in value.

The phenol portion of the output is derived from the benzene part of the initial input. In the same way, the acetone produced is attributable to the low-cost propylene third of the feed.

As compared with other processes, the latter product—acetone—at present prices provides a bonus for the phenol produced as a major product. Moreover, the comparatively small quantity of methyl styrene produced can be separated for use in the plastics industry, or it can be converted back to cumene and re-used in the process.

For further information, technical data, etc., relating to chemical or petrochemical processing, write

CHEMICAL PROCESS DIVISION

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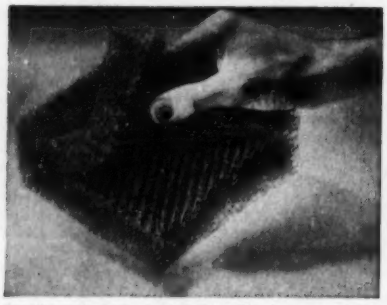
Liquid Carry-Over Economically Controlled by Separators Made of Knitted Wire Mesh

When the removal of unwanted – and often contaminating – liquid particles entrained in a gas is considered as basically similar to the filtering of solid particles from the same type of carrier, the simplicity and effectiveness of knitted wire mesh entrainment separators is more readily understood.



Small section of a Metex Mist Eliminator opened to show construction.

Known as Metex Mist Eliminators, these separators are built up from layers of knitted wire mesh into a unit, foraminous in structure, which removes the liquid particles by impingement and accumulation in depth. Though operating on the same principle as air filters of this type, they have one distinct advantage. The filtrant being liquid will drain from the Mist Eliminator by gravity. Entrainment removal can therefore be considered as a "continuous" rather than a "batch" operation since the "filter" does not have to be cleaned.

Metex Mist Eliminators were first used about 10 years ago to remove the liquid entrainment in a fractionator tower in one of our leading petroleum refineries. The efficiency of, and the operating economies effected by, this first installation have since been repeated in unnumbered operations which include not only petroleum refining, but petrochemical and chemical processing operations in this country and abroad.

Mist Eliminators can be easily installed in new or existing vessels. They have no moving parts to require power or servicing and need no special housings. Experience shows that they will operate over an unusually wide range of velocities with a pressure drop generally less than 1" of water. Entrainment removal efficiencies of 99% and better are commonly reported. For full information write Entrainment Separator Department, Metal Textile Corporation, Roselle, New Jersey.

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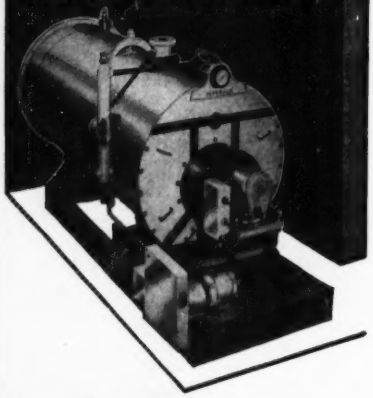

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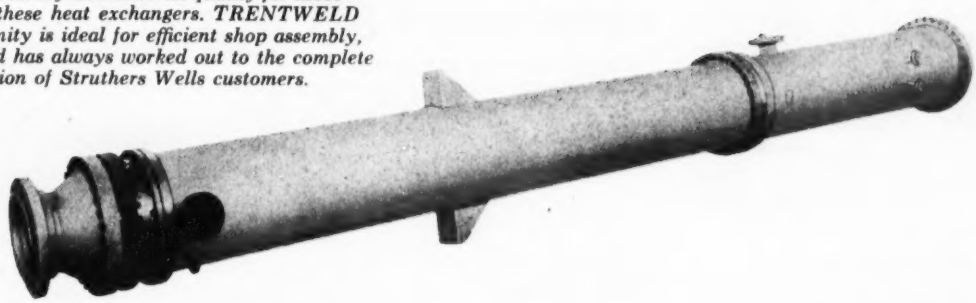

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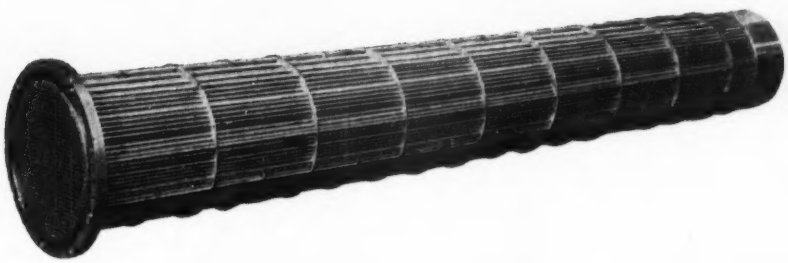

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Wax kept in, solids screened out of shellac

Clearing a shellac solution of 5% undissolved solids, such as dirt, bark and insect bodies, without also removing the wax, presented a problem to an Oregon chemicals firm. An 18" dia. SWECO vibrating screen separator handled the assignment, screening the solution (crude shellac in a 1% soda ash solution.) Company now obtains the desired clearance of foreign matter, using 100-mesh screen cloth. Solution weighed approximately 65–70 lbs. per cu.ft., with specific gravity of 1.04 to 1.12.

Separation of solids from brine-potash solution

"Very gratifying" was the verdict of a Texas chemicals firm after using a SWECO vibrating screen separator to remove solids from a highly corrosive brine-potash solution. Need was particularly urgent because the solution was so corrosive that the company was incurring heavy expenses in scraping, painting and replacing steel plates in the classifiers. Initial demonstration, using 20-mesh cloth, was very satisfactory. Company now has two 48" diameter SWECO vibrating screens, uses a range of cloths: 16, 20, 30, and 35 mesh.

Free screening analysis and recommendations...SWECO District Engineers are available to make detailed analyses and recommendations on specialized screening operations without cost to you.

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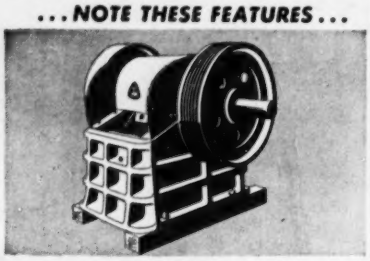

DENVER JAW CRUSHER

Size: 5" x 6" to 32" x 40".

Features: Steel Frame, anti-friction bearings, Manganese steel liners.

Price examples, less drives. FOB Denver.		
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	8" x 10"	1375.00
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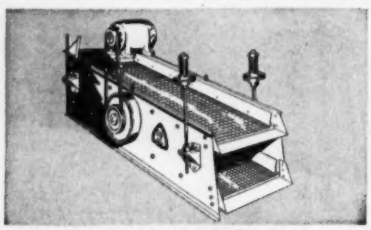

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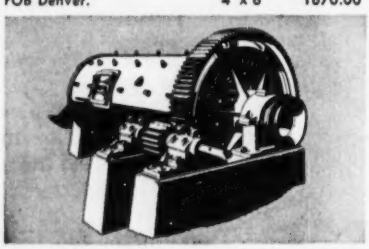

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Features: Cast steel heads, cut tooth gears, protected trunnion bearings and manganese steel liners.

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CaO .56	MgO .04	K_2O .005	Na_2O .004	B_2O_3 .001
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CaO 5.20	MgO 1.01	K_2O .001	Na_2O .003	B_2O_3 .001

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Different crystal structures account for the different successful uses of these two oxides. Pure oxide, having monoclinic crystals, undergoes an inversion of crystal structure and a 7 per cent volume change at about 1000° C. The introduction of calcium oxide, during the process of creating stabilized oxide, locks each crystal in a cubic form which remains constant to its melting point of 4700° F. The other important difference between these two oxides is the necessarily larger percentage of calcium present in the stabilized oxide. A-9579

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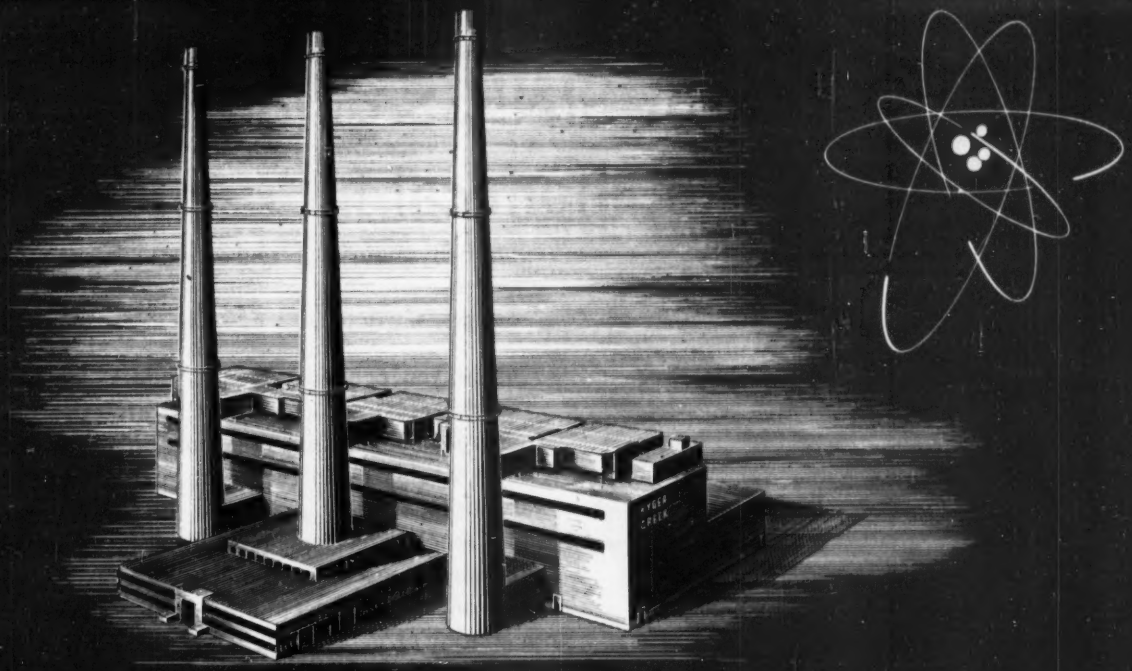

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The Ohio Valley Electric Corporation was formed by a group of 15 neighboring electric light and power companies. Kyger Creek is one of the two steam power plants being built to supply the power needs of the U.S. Atomic Energy Commission's new diffusion plant in Pike County, Ohio.

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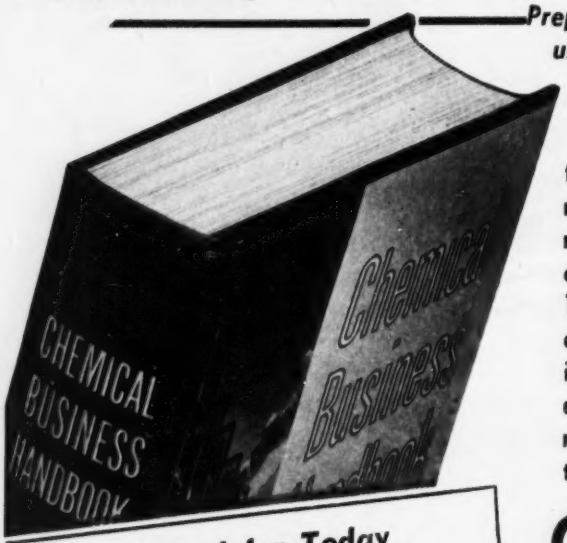

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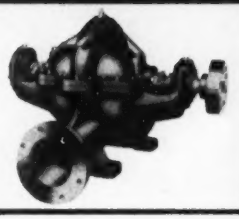

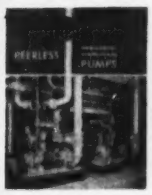

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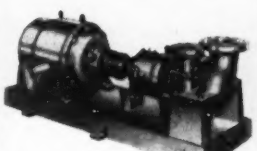

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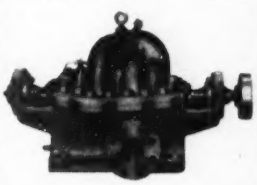

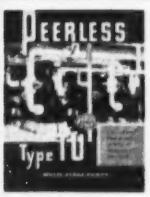

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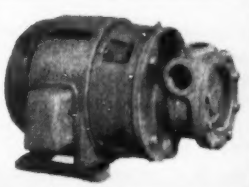

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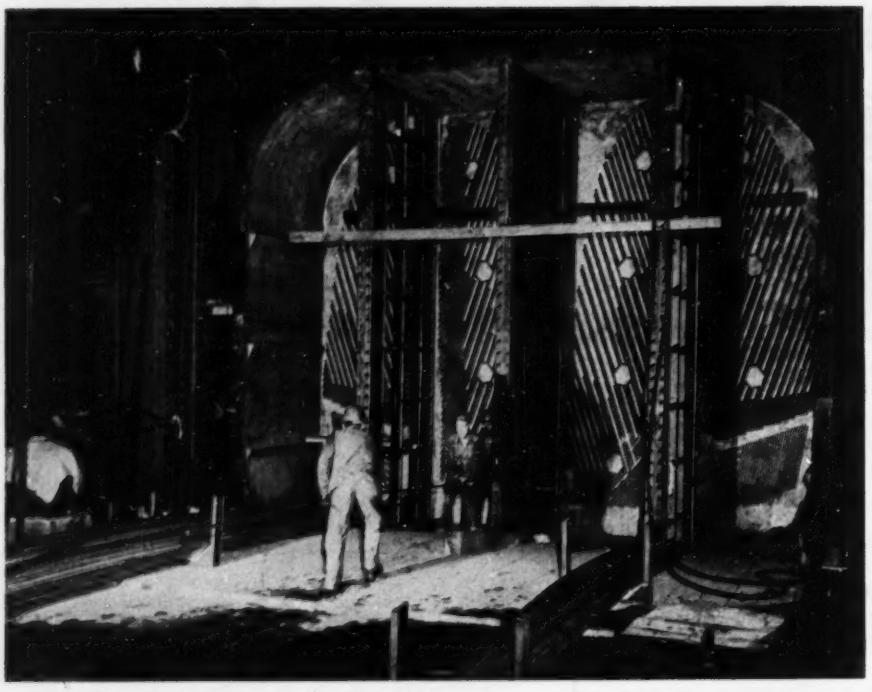

Aluminum Brass Tubes being installed in the world's largest surface condenser. More than 104 miles of tube are being used. As work progresses, platform is gradually raised. (Courtesy Consolidated Edison, New York)

World's Largest Single-Pass Surface Condenser Uses Arsenical Aluminum Brass Tubes

A giant new condenser with a total surface area of 125,000 square feet is being installed at the East River generating station of the Consolidated Edison Company of New York.

It contains 18,360 Arsenical Aluminum Brass Tubes, 7/8 inch O.D., No. 18 BWG, each 30 feet in overall length. Laid out in a straight line, these tubes would extend for 104 miles.

The new condenser is a horizontal, single-shell, single-pass unit with vertically divided water boxes. According to the manufacturer, Worthington Corporation, it is the largest condenser of its type ever built.

Generating Capacity Increase

East River station's net capacity is now 589,000 kw. When Unit No. 7 goes into operation in the Spring of 1955, the net station capacity will be about 762,000 kw. The new turbine combination is rated at 180,000 kw, 3600/3600 rpm. Each generator is rated at 100,000 kva, 0.8 power factor, 3-phase, 60-cycle and 13,800 volts, with ½ lb. hydrogen cooling pressure.

The unit's low-pressure element, comprising two double-flow turbines on a single shaft, will exhaust into the condenser, which is guaranteed to condense 980,000 pounds of steam per hour with a back pressure of 2 inches of mercury absolute when provided with 130,000 gallons of water per minute at 75 degrees Farenheit. Since the average temperature of river water used for condenser cooling is well below 75 degrees, the condenser is expected to maintain a back pressure of less than 1 inch of mercury absolute for most of the year.

Aluminum Brass Tubes

Arsenical Aluminum Brass was selected by Consolidated Edison Company of New York engineers, on the basis of many years of very satisfactory service, as the most economical condenser tube alloy for long, trouble-free life at this station. The alloy selection is particularly important in view of the corrosive nature of the East River water used in the condenser. Although called a river, this body of water is by nature actually a tidal flow with considerable corrosive characteristics because of its salt water, and industrial and urban waste content.

Bridgeport's Arsenical Aluminum Brass Condenser Tubes (Alloy No. 54) are among those used in this huge new condenser unit. Tubes of this alloy are giving excellent service in many other plants at tidewater locations. In these installations, the economy of using Bridgeport Arsenical Aluminum Brass has been proved by long tube life, reduced maintenance, and more efficient operation.

Bridgeport's Technical Service and Corrosion Laboratory are always ready to help you select the most economical Bridgeport Condenser Tube Alloy for your installation. Call your local Bridgeport Sales Office to use these services to your advantage.

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Here's an efficient way to deliver a potent one-two punch to condenser tube problems. Specify Wolverine Trufin*—Type S/T.

Result—you boost condenser tube surface area—get *more* BTU's per foot of tube—increase operating efficiency—reduce operating costs.

Wolverine Trufin—Type S/T—is extended surface condenser tubing designed primarily for shell and tube heat exchangers. The O.D. of the plain ends is slightly larger than the O.D. of the fins. Because the fins are integral—actually part of the tube—they retain high efficiency despite high temperature, pressure or vibration.

Trufin is available in copper, copper-base alloys, aluminum, electric-welded steel and stainless steel. Where jobs call for prime surface tubing, you can select from Wolverine's three metals: copper (and its alloys), aluminum, or electric-welded steel.

Obtain all of your condenser tube requirements from one source. No matter what they are, finned condenser tubing, plain condenser tubing or U-Bend (plain or finned condenser tubing) Wolverine has a wide range of sizes and alloys.

If you need help, tube technicians from Wolverine's Field Engineering Service are more than eager to be of service. Write today for Wolverine's new booklet describing how to reduce your heat exchanger cost with Trufin Type S/T condenser tubing. It's packed with data on Trufin economies. WOLVERINE TUBE, Division of Calumet & Hecla, Inc., 1443 Central Avenue, Detroit 9, Michigan.

*REG. U.S. PAT. OFF.

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario.

WOLVERINE TUBE
DIVISION OF CALUMET & HECLA, INC.
Manufacturers of Quality-Controlled Tubing

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.
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HORIZONTAL PROCESSING

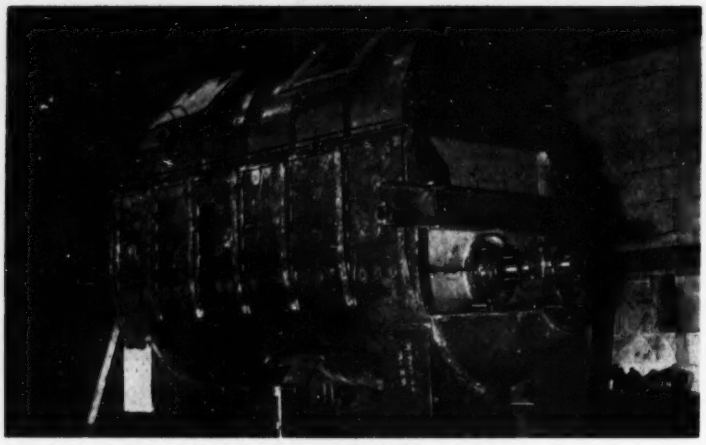
Offers Advantages

for difficult operations such as:

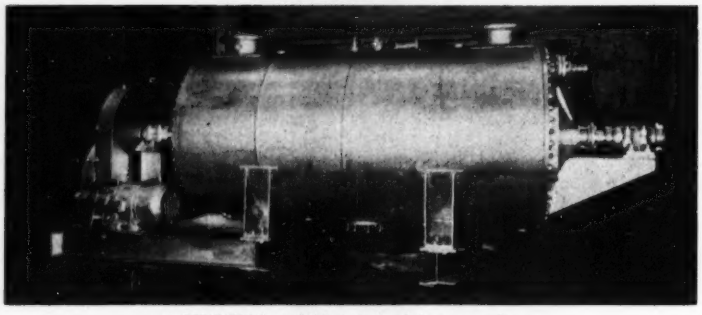
- evaporation of water and solvents from slurries, sludges, and pastes.
- drying of solids.
- reaction between gases and solids or materials of high consistency.
- sublimation.

HORIZONTAL PROCESSING UNITS
BY BETHLEHEM MEET THE DEMANDS WHICH THESE OPERATIONS MAKE FOR

- intense agitation to break up or shear material.
- circulation to blend or maintain reasonably constant composition.
- scraping at walls and plowing action for required rate of heat transfer.
- exposure and renewal of surface for contacting with gases or release of vapors.



A BETHLEHEM stainless steel unit with stud bolted steel jacket for drying a delicate solid.



A BETHLEHEM steel fabricated unit to evaporate solvents from a sludge.

BETHLEHEM has the processing know-how for many of these obscure operations plus the design background and shop workmanship to produce equipment for heavy duty, long life and effective processing.

For your processing problems involving solids and materials of high consistency, consult our engineers, who have the chemical, mechanical, and metallurgical background to help you meet your needs.

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CHEMICAL PROCESS DIVISION

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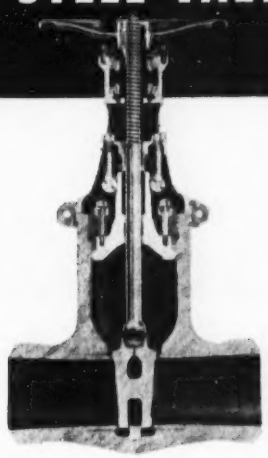

Cross section of 8-inch Series 900 Walworth Pressure-Seal Cast Steel Gate Valve. Pressure-Seal Globe, Check, Angle, and Non-Return Valves are also available in Series 600, 900, 1500 and 2500 in a wide range of sizes.

Better because ... **They have no bonnet flanges, bonnet bolts, or bonnet welds. Ideal for high-pressure, high-temperature steam service and corresponding boiler feed service, Walworth Pressure-Seal Cast Steel Valves weigh less, and take up less space than the flanged bonnet type of valves used for similar services.**

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Ask for your copy of Walworth Circular 143. It gives detailed information, including sizes, dimensions, and specifications for all Walworth Pressure-Seal Cast Steel Valves.

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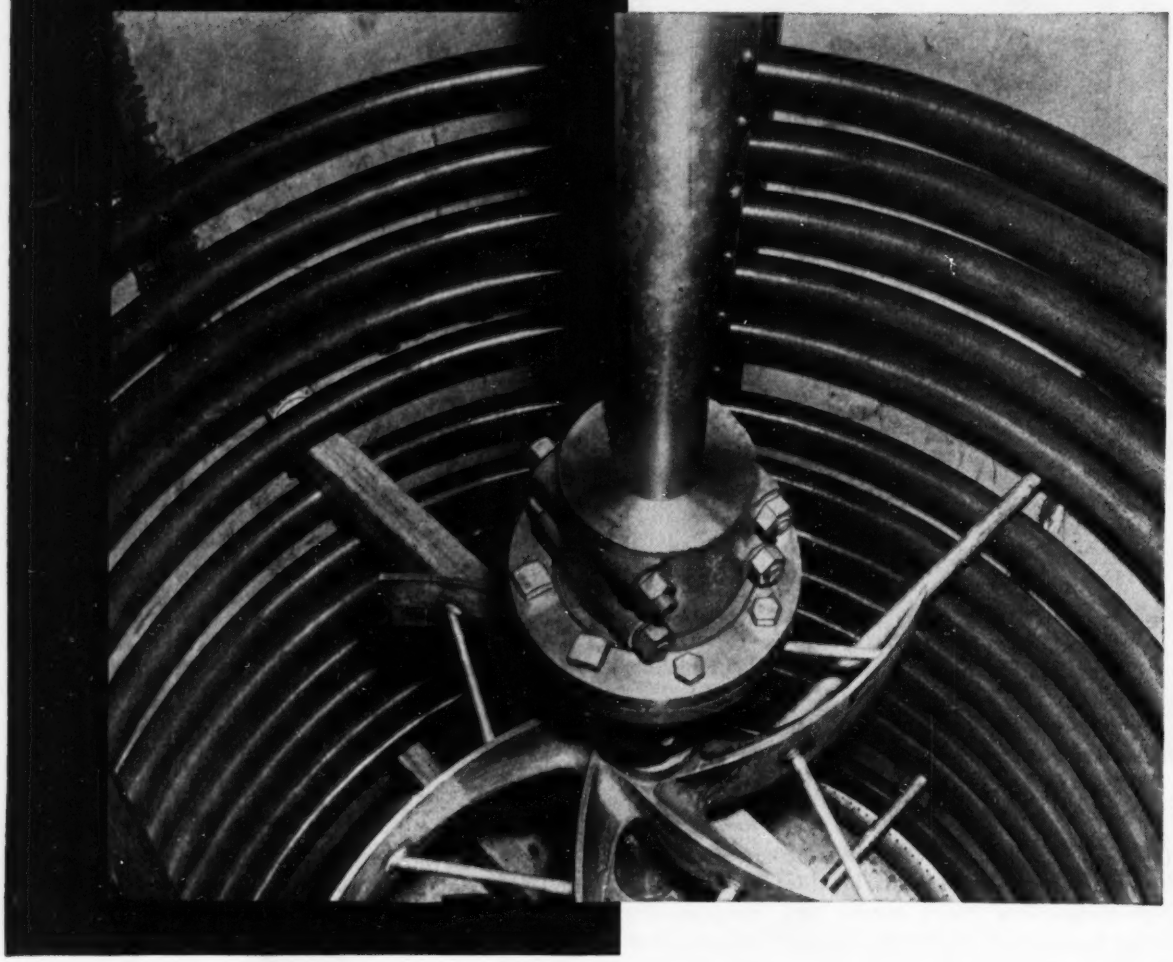

Shown above is one section of a 12,000 gallon processing tank for penicillin and streptomycin. In the tank, cultures are heated to 280° then cooled to 55°. The heating and cooling coils had to be easy to clean . . . resistant to corrosion . . . have a low rate of thermal expansion . . . give trouble-free, smooth bending and coiling, and be easy to weld.

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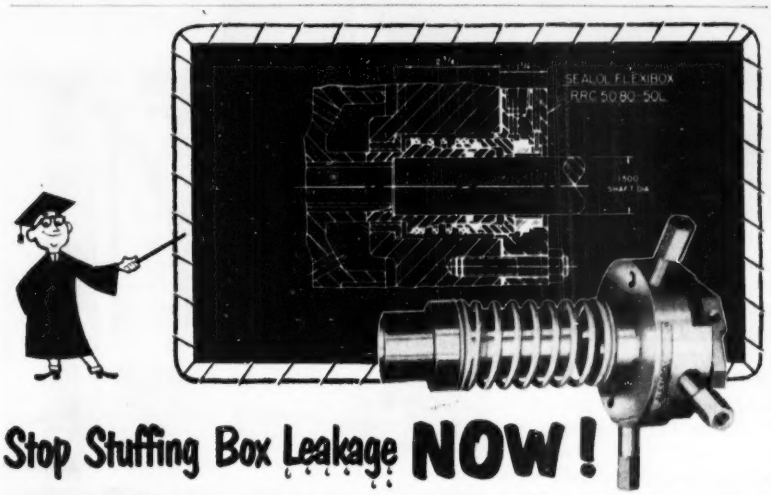

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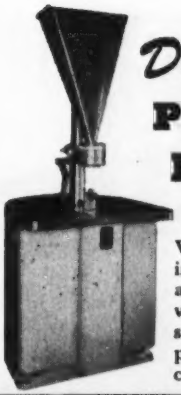

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Vacuflow powder filling equipment operates on a principle of vacuum feeding, instead of pressure, to pack powder into a container.

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Air is removed from the container to create a vacuum which draws a measured quantity of powder from the hopper. There is no problem with dust control, since the unique Vacuflow method simply does not involve air currents that cause dust.

Semi-automatic models are available for filling containers ranging from the tiny talcum box up to and including 100 lb. paper bags and 200 lb. drums. Rotary models are available for automatic production of 5 lb. sizes or less at speeds of 45 to 300 per minute.

Pneumatic is the one manufacturer in a position to furnish machines for making up complete production lines. Units are available for air cleaning, powder and liquid filling, capping and labeling a wide range of bottles, cans or jars.

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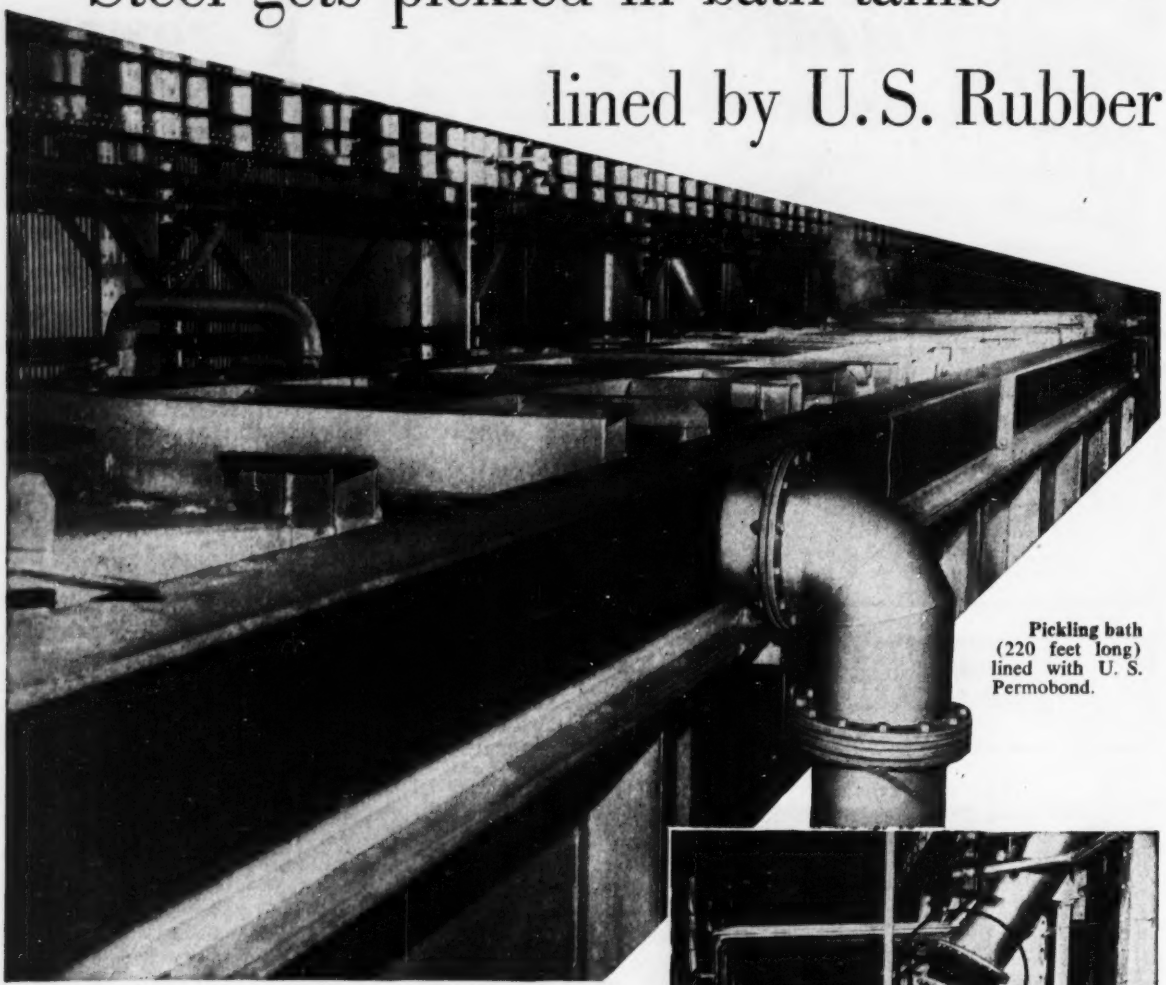
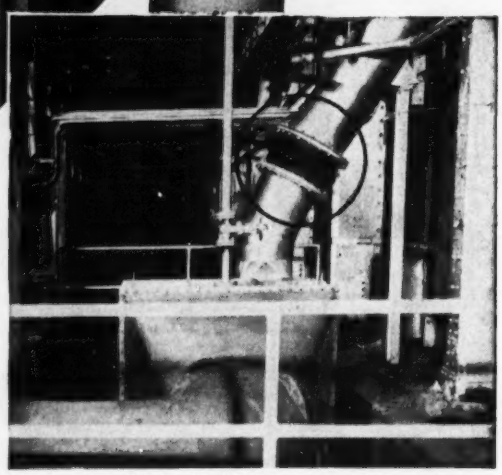
PNEUMATIC

Steel gets pickled in bath tanks lined by U.S. Rubber



Pickling bath (220 feet long) lined with U. S. Permobond.



Duct system lined with U. S. Permobond conveying sulphuric acid fumes to outside of plant. Note U. S. Expansion Joint at right.

Many steel plants handle the hot corrosive acids used in pickling operations by means of tanks lined with Permobond, a product made and installed by United States Rubber Company. Without this rubber, the hot acids would "eat" and corrode the metal tanks.

Typical is this large Midwestern steel plant. The complete pickling unit, acid bath tanks and covers, rinse tanks, fume exhaust system, including a large stack, are all "Permobond-protected."

This steel plant also uses U. S. Expansion Joints to counteract expansion and contraction in pipe lines forming the duct system. And to provide flexibility, U. S. Pilot Flexible Pipe is used in the downcomers.

The "U. S." complete engineering service which designed, accurately fabricated, and Permobond-lined the many complex weldments into a finished, efficient pickling line is available to all industry. Consult any of our 25 District Sales Offices or write to address below.

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"U. S." Production builds it.
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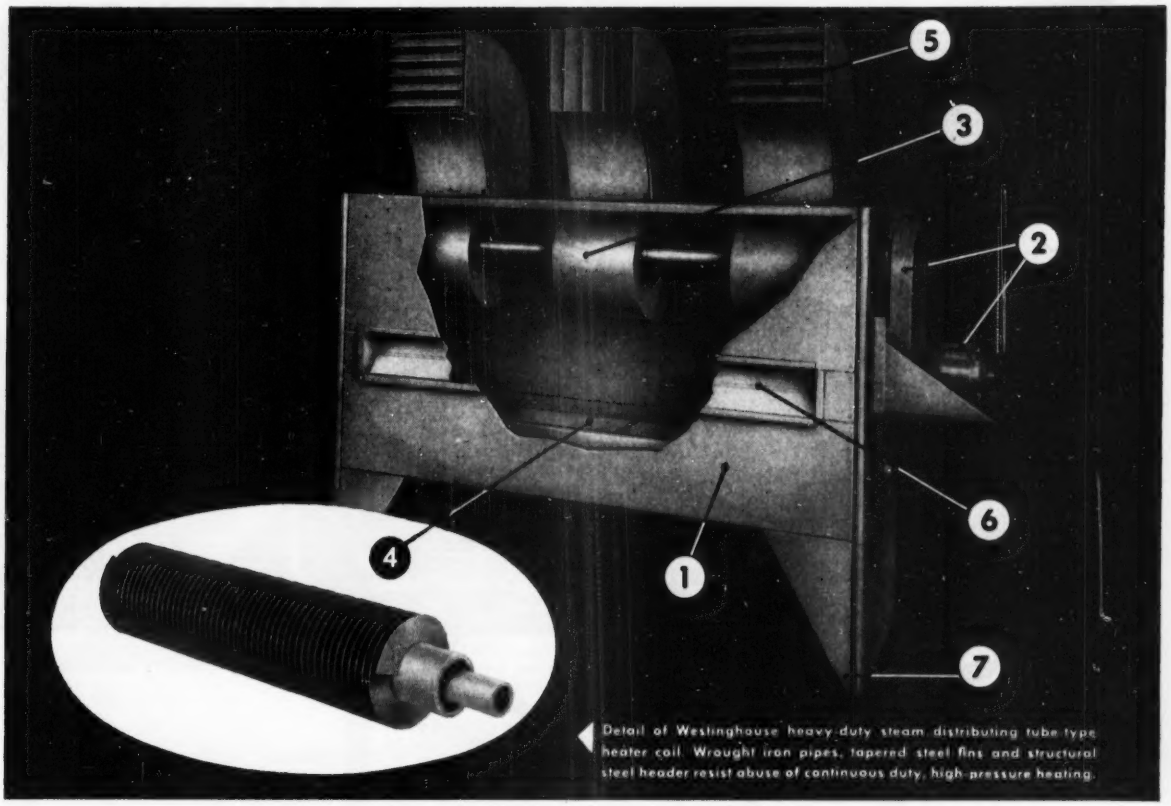

Detail of Westinghouse heavy-duty steam distributing tube-type heater coil. Wrought iron pipes, tapered steel fins and structural steel header resist abuse of continuous duty, high-pressure heating.

Rugged, Quiet Westinghouse Industrial Heaters . . . Designed For Continuous Heavy-Duty Systems!

Seven Features Assure Dependable, Versatile Coverage of Large Areas

Westinghouse Industrial Heaters supply ideal heat under difficult conditions. In plant, warehouse, garage and similar buildings, these heaters efficiently blanket large work zones, even those with high ceilings, frequently opened doors and expansive window areas. They also supply make-up air for exhaust systems . . . may be used to circulate ventilating air during warm seasons. Capacities in six sizes range up to 2,500,000 BTU/hr . . . 25,000 cfm . . . 200 psig steam pressure.

Each Westinghouse Industrial Heater is a complete unit. That's why each can be placed where it will do the most good . . . whether on floor, or wall (upright or inverted), or suspended from ceiling. Economically selected and scientifically grouped, Westinghouse Industrial Heaters satisfy the needs of areas of any size or shape, and can be readily relocated to suit plant layout changes.

Westinghouse Industrial Heaters have a line-up of features that is unique:

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2. Standard motors have adjustable V-belt drive on units with motors up to 5 HP.
3. Powerful, yet quiet, fans are multiblade centrifugal type mounted on a common shaft. Blades are forwardly curved.
4. Efficient steam coils are heavy-duty or general purpose. Former are wrought iron for extra-long life (see detail shown above); latter are standard or steam distributing copper-tube type.
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7. Rounded corners, smooth surfaces eliminate accidents, minimize dirt.

These features are backed up with a Westinghouse-Sturtevant exclusive—a single equipment warranty with undivided responsibility. This unit responsibility is your greatest guarantee of dependable performance for years to come. For complete details call on the Westinghouse-Sturtevant air handling specialist conveniently located in your area. Or write: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE...IF IT'S Westinghouse

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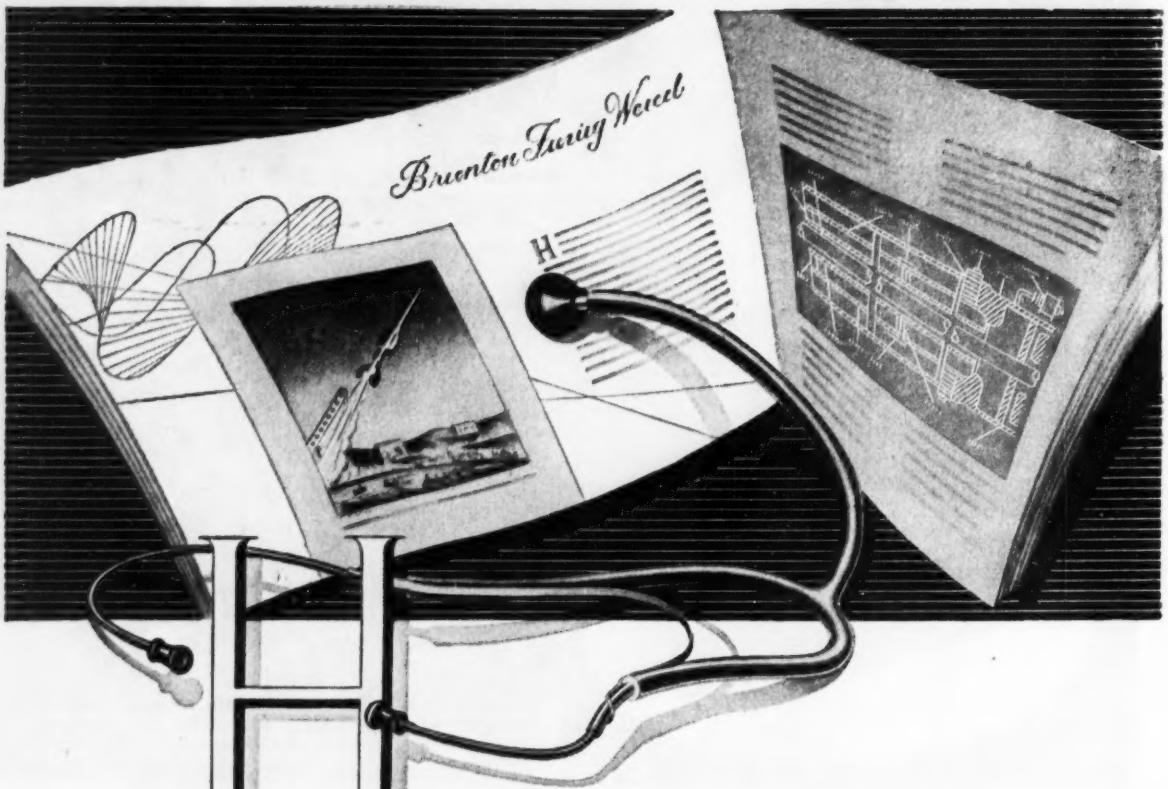

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1—Read Standard horiz. dbl. ribbon Mixer, center disch. 8'x36"x42", 2,000#, 480 gal., practically new.
1—S.W. 5'x10' stainless single Drum Dryer, 100#, m.d.
1—#28 Devine Vac. Shelf Dryer, 20-59"x78" Shelves, complete.
1—Troy 6"x14" high speed 3-roll mill roller bearing m.d. late type.
3—3'x50' Rotary D.H. Dryers or Coolers.
6—Sperry 18"x18" iron recessed Filter Presses, 18 chambers.
7—Pebble Mills, 800 gal. 6'x8'; 235 gal. 5'x4'; 125 gal.; 50 gal.; 25 gal.
1—Bartlett & Snow Jacketed Closed Agitated Kettle, 1800 gal., 10' dia.x 4' deep.
1—S. W. 5'x10' stainless single Drum Dryer, 100#, m.d.
4—Mikro Pulverizers, 4TH, 2S1.
3—Majonnier S/S Vac. Pans, 3', 4', 6'.
3—Anco 4'x9' Chilling Rolls.
1—6'6"x12' Rotary Granulator or Dryer.
3—B & J Rotary Cutters, #2, #1.

HERE ARE MORE SAVINGS

3—#12 Sweetland Pressure Filters made by Oliver-United Filters, Inc. 48 leaves on 3" c/c. Leaves are bottom drainage, grooved rim, bronze with AU monel covering. Cap. each: 642 sq.ft. filtering area, 56 cu.ft. cake. Wt. 24,000# each. Latest type, 2 Unused—1 slightly used.

2—STAINLESS STEEL Baker-Perkins "Termeer" Continuous Centrifugals, Model S-12-SB. Pumps, all controls and XP motors included. Each handles approx. 600#/hr. of solids from 1500# of slurry.

1—ALL MONEL Enzinger pack. pressure Filter, 8 leaves, 75 psi W.P., 38 sq. ft. filtering area, 2.8 cu.ft. cake volume.

2—CME CONTINUOUS CENTRIFUGALS, STAINLESS STEEL, 21" solid bowl, handles 10/20 gpm 1000/2000# cake discharge per hour. 30"x40" solid bowl, #316, handles 25/50 gpm, 2000/4000# cake discharge per hr. UNUSED. Also two lab. size 7" solid bowl and screen types, stainless steel, available for testing.

2—Link-Belt Co. Roto-Louvre Rotary Dryers. One is #502-16, Type C, 5'2" dia.x16' long, with #304 STAINLESS STEEL contact parts. The other is #207-10, 2'7" dia.x10' long; carbon steel construction, complete with all auxiliaries.

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1—300 Gal. Stainless Steel Vacuum Pan.
1—Sharples C-20 Super D-Hydrator.
1—Oliver 6'x6' Rotary Filter, acid proof.
1—Baker Perkins size 15 JUE, dbl. sigma blades, 100 gal. Mixer.
1—Day #30 Imperial dbl. sigma blade, jack. Mixer, 75 gal.

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1—2600 sq.ft. Heater, Cupro Nickel tubes, 8' long.
6—180 sq.ft. Heaters, Cupro Nickel tubes, ⅝" O.D.
1—292 sq.ft. Jacket Water Cooler, admiralty tubes, 8' long.

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FILTERS

1—Vallez 41 Stainless Covered Leaf Filter, type 49.
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10—Sperry & Shiver 12", 15", 18", 24", 30", 36", iron & wood Filter Presses, also disc Type.
Sweetland & Oliver Rotary Vac. Filters.

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1—15 gal. Autoclave, agitated.
1—Dopp 350 gal. C.I. Jack. Vac. Kettle.
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Devine 1000 gal. closed Jack. Steel Kettle.
1—2300 gal. vert. agit. Jack. Steel Kettle.
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New Stainless Steel Tanks 50 to 10,000 gals.
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Copper & Stainless Varnish Kettles.
Patterson 30" x 42", 6' x 5', 6' x 8' Pebble Mills.
Abbe 24" x 33" & 30" x 36". Also Jar Mills.
#1 Raymond Automatic Pulverizer 20 H.P. motor.
1—Raymond #00 Pulverizer 30 H.P. Complete.
4—#0000 Raymond Mills.
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Williams 5 Roll Super Titan Roller Mill.
Hammer Mills & Pulverizers 3 to 50 H.P.
1—Schultz-O'Neil 20" Pulverizers. Also #1.
Williams # 2X Hammer Mills 35 H.P.
1—Robinson 18" & 22" Attriton Mills.
1—Lehman 4 Roll W.C. 12x 36" Steel Mill.
3—Steel 3 Roll Mills 9"x32", 12"x30" & 16"x40".
1—9" x 36" Double Steel Roller Mill.
1—40" x 24" 3 pr. high steel Roller Mills.
3—Hauchin 18" x 36", 4 Roll Granite Stone Mills.
Ball & Jewell Rotary Cutters, Midget Lab. & #1.
2—U. S. & Premier 1½ H.P. Colloid Mills.

MIXERS & SCREENS

Baker Perkins double arm 100, 50 & 9 gals.
5—American Tool 300 gal. Churns.
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4—Day 2½, 8, 15 & 40 gal. Pony Mixers.
1—Century 2 H.P. 4 speed Vert. Mixer.
1—Lead & Paste Mixers 50 to 150 gals.
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Patterson 42" dia. Stainless Conical Blender.
1—Master Drum Type Blender 1000#.
10—Dry Spiral Mixers 50 to 3000#.
12—Portable Elec. Agitators ¼ to 3 H.P.

MISC. & SPECIAL

2—Leominster 8 oz. Injection Molding Machines.
Stokes #820, 4" dia. Preform Machine.
Anderson & French Oil Expellers.
Sly Dust Collector, Bag Type, 242 sq. ft. complete.
150 gal. Post or Change Can Mixer.
Gould 75 HP Centrifugal Pump. 250 PSI.
Pneumatic Scale Automatic Capper M.D.
1—Marco 200 Stainless Steel Homogenizer.
Filling Machines for Powder & Paste.
Liquid Filling Machines & Labelers.
Rotary & Single Punch Tablet Machines, ⅛" to 4".
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Soap Machinery for Toilet Laundry, Chip Liquid.
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210 CFM Worthington (GAS & DIESEL) Portable
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3—Reeves 7'x170', ⅝" shell.
1—Vulcan 8'x125', ¾" shell.
2—Allis Chalmers 9'x80', ⅝" shell.
1—Link Belt 7'x45', ½" shell.
1—F. L. Smidth 4'x30', ⅜" shell.
1—Allis Chalmers 6'x35' Rotary Dryer.
1—Vulcan 4½'x50' Rotary Dryer.
5—Link Belt, Hersey Rotary Dryers 2'7"x8', 3'x24', 3'10"x16', 7'5"x20' stainless steel.
4—Louisville Steam Tube Dryers 6'x50', 6'x30', 5'x28', 3'x20'.
4—Devine Vacuum Shelf Dryers with 20, 14, 6 and 4—40"x43" shelves.
3—Stokes and Buflovak Rotary Vacuum Dryers 30"x8', 3'xx15', 5'x30'.
4—Buflovak double drum 60'x144", 42"x90", 36"x84", 32"x52".
1—Devine 2'x4' Vacuum Drum Dryer 316 S.S.
2—Buflovak 6' dia. Crystallizers.

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Filters

1—Oliver 1'x1' Rotary-Vac Filter 316 S.S.
2—Oliver Monel 8'x10' Rotary-Vacs.
2—Eimco 8'x8', 4'x5' Rotary-Vac complete with pumps, drives, piping, etc.
8—Oliver Rotary Vacuum 11'6"x18', 11'6"x 14', 8'x12', 8'x10', 8'x8', 8'x6', 3'x1'.
2—Sweetland #12 with 72 and 36 leaves.
1—Niagara #110-20 with 12 S.S. leaves.
1—Sparkler #33-S-17 steel filter.
3—Vallez 500 sq. ft. Rotary Pressure.
1—Shriver 36" P&F 42 chambers.
4—Shriver 30" P&F 30 chambers.
8—Sperry 24" P&F 16 chambers.
2—Sperry Aluminum 30" and 24" P&F.
10—Shriver, Sperry Filter Press Skeletons 42", 36", 30", 24", 18".

Centrifugals

1—Bird 48" Suspended Monel.
1—Bird 40" Suspended 347 S.S.
2—Bird 40" Suspended, rubber covered.
1—AT&M 36" center slung, rubber covered.
1—Fletcher 30" Suspended, steel.
1—Tolhurst 26" Suspended, steel.
2—Tolhurst 30" center slung, steel.
1—Bird 36"x50" solid bowl, stainless.
4—Bird 36"x72", 36"x50", 18"x28" solid bowl, continuous.
1—Sharples Nozzlector DH-2, 304 S.S. 15 HP motor.
2—Sharples C-27, C-20 Stainless Steel Super-D-Hydrators.
2—Sharples #16P Monel and 3S Super Centrifuges.

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1—9' O.D. x 61'6" SS, 15 trays 50#, 300°F.
1—7'6" O.D. x 55'6" steel, 30 trays 45#, 300°F.
1—7' I.D. x 42' steel, 20 trays 40#, 150°F.
1—7' I.D. x 25'6" SS, 10 trays, 50#, 250°F.
1—6' I.D. x 64' steel, 35 trays, 55#, 300°F.
1—6' I.D. x 45' SS, 15 trays, 850#, 350°F.
1—5' O.D. x 61'6" steel, 15 trays, 55#, 300°F.
1—4' O.D. x 72' SS, 40 trays, 75#, 300°F.
1—3'6" I.D. x 63' steel, 35 trays, 55#, 250°F.
1—2'6" I.D. x 60' steel, 35 trays, 55#, 300°F.
1—2' O.D. x 75' steel, 45 trays, 55#, 300°F.
1—2' I.D. x 39' SS, 40 trays, 70#, 300°F.

Heat Exchangers—Condensers

2—1440 sq. ft. 304 S.S. 75# PSIG, 340°F.
3—1345 sq. ft. steel, 70# PSIG, 300°F.
2—1125 sq. ft. steel, 850# PSIG, 900°F.
9—Kettle type reboilers, steel & SS, 1250, 1125, 750, 660, 400 & 340 sq. ft.
58—Atmospheric heat exchanger units, 304 stainless steel, 715, 477, 358 & 108 sq. ft.

Other Items

1—Union Boiler 300 HP, 225# W.P.
5—Clark Air Compressors, gas driven, Model RA8, 800 BPH, 2 and 4 stage.
2—Oliver 8'x10' Monel, Rot. Vac. Filters.
2—#12 Sweetland Filters 36 leaves.
2—10,000 gal. steel welded Pressure Tanks 175# PSIG.
10—6'x30' ASME Horizontal Storage Tanks, 75# pressure.
4—IR 24" Centrifugal Pumpss 8000 GPM Engine operated.
1—Union 6' 4 stage Centrifugal Pump 1000 GPM Engine operated.
90—Centrifugal Pumps 1½"x1" to 8"x6" steel and stainless steel.
3—I.R. Propane Compressors steam driven 5410# per hr.
2—Clark Bros. gas Engines 4100 CFM model MA-4 150 BHP.
3—High Pressure Furnaces Natural gas fired, 2½ to 15 million BTU per hr.

Pulverizers—Crushers

1—Devine 5'x10' steel, jacketed Ball Mill.
4—Abbe 6'x10' porcelain lined, jacketed, Pebble Mills.
2—Raymond 3 and 5 Roll High Side Mills.
4—Hardinge Mills 4½'x16", 5'x22", 5'x36", 6'x22", 10'x48".
1—Bauer 36' Attrition Mill 2—50 HP motors.
6—Patterson 8'x8', 5'x6', 4'x5', 2½'x3½'. brick-lined Pebble Mills.
5—Abbe 3'x4', 3'x3½' Pebble Mills.
2—Premier Colloid Mills 8" dia., S.S.
1—Jeffrey 30"x24" Hammer Mill, Type A.
3—Raymond, Gayco Separators 12', 8', 6'.
5—Mikro Pulverizers #2DH, #2TH, #1SH, #1SI and Bantam.

Screens

1—Day #81 single deck 40"x120".
1—Patterson single deck 40"x84" S.S.
1—#42 Rotex double deck 40'x84".
2—#12 Rotex double deck 20"x48".
4—Tyler Hummer 4'x15', 4'x10', 4'x5' single deck with V-16 Vibrators.

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Mixers

4—Baker Perkins 300, 100, 50 and 1 gal. sigma blades, jacketed.
1—Baker Perkins 50 gal. JEM, 50 HP.
1—Baker Perkins 35 gal. S.S. jacketed.
1—Robinson 4000# steel powder.
6—Rodgers 400 to 3000# powder.
4—Simpson Intensive Mixers #0 and #00.
8—New Portable Agitators ¼ to 5 HP.
4—Day, Ross 8 and 50 gal. Pony.

Kettles—Stills—Condensers—Tanks

1—Pfaudler 500 gal. glass lined, jacketed, agitated Reactor.
2—Blaw Knox 800 gal. S.S. agitated Reactors 200# int. press.
6—Buflovak, Zaremba and Kilby Evaporators 300 to 14,000 sq. ft.
9—Heat Exchangers, S.S. 50 to 1000 sq. ft.
5—Buflovak Condensers 20 to 90 sq. ft.
2—Groen 125 gal. S.S. jktd., agitated Kettles.
1—2800 gal. 316 S.S. Tank with coils.
3—2300 and 1400 gal. Aluminum Tanks.
6—Glass-lined Storage Tanks 6000 and 8000 gals.
1—Blaw Knox 13,000 gal. steel welded Pressure Tank 200 PSI.

Miscellaneous

7—Stokes Vacuum Pumps 10 to 100 CFM.
10—Stokes DD2, D4, D3, B2 Tablet Machines.
10—Nash Pumps TS12, TS8, H7, L3, MD571, #4, #2.
2—Cumberland #0 Rotary Cutters.
4—Olivite, Duririn rubber and stainless steel Centrifugal Pumps 1" to 6".

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Centrifugal: Fletcher 20" perf. basket.
Centrifugal: Fletcher 17" stain. steel.
Centrifugal: Bock 17" perf. monel basket.
Centrifugal: Fletcher 18" perf. copper.
Clarifier: De Laval model 84-51, 3 hp.
Compressor: Nash Hytor L-4, 25 hp.
Condenser and Receiver: Stokes 43 sq. ft.
Crusher, Jaw: Denver #1, 3" opening, 1 hp.
Crusher, Rotary: Sturtevant #1.
Cutter, Rotary: Ball & Jewell No. 1½.
Dryer, Vacuum Drum: Devine 24x48", 316 st. st.
Dryer, Steam Tube: 14" x 72", st. steel.
Feeders: Syntron Vibraflow model F-22.
Filters: Alsop, Sparkler, Lemax.
Filter Press: Aluminum 15" P&F 18 chamber.
Filter Press: 24" 27 chamber wood P&F.
Filter Presses: Cast iron, recessed and plate and frame, 7" to 24".
Heat Exchanger: Karbate 16 sq. ft.
Heater, Tubular: 65 sq. ft. stain. steel.
Kettles: 50 gal. st. steel, jktd., agtd.
Kettles: Aluminum, stain. steel, steel.
Mills, 3-roll: Day 5 x 12", 16 x 40".
Mill, Hammer: Williams BX, 40 hp.
Mill, Hammer: Williams #2 slugger type.
Mills, Hammer: 3 hp. Prater, 7½ hp. JayBee.
Mill, Screen: Raymond 16", 7½ hp.
Mills, Colloid: Premier 3 hp and 7 hp.
Mill, Colloid: Eppenbach model E, ¼ hp.
Mill, Attrition: Sprout-Waldron 20", 15 hp.
Mill, Jar: Abbe #5, 36 gallon.
Mill, Pebble: Abbe,25 gallon.
Mixer: Simpson Intensive 36", stain. steel.
Mixers: double arm, up to 100 gal. cap.
Mixers: single arm, up to 100 gal. cap.
Mixers, ribbon: 800 lb. jacketed.
Mixer, ribbon: 800 lb., stain. steel.
Mixers, Pony: 8, 20, 40 gal. cap.
Mixers, Portable: ¼ hp to 5 hp.
Press: Davenport #3A bronze rotary.
Presses, Hydraulic: 15 and 50 ton.
Presses, Tablet: Colton and Stokes.
Pulverizers: Mikro 2DH 10 hp., 2TH 15 hp.
Pumps: Centrifugal, rotary and gear.
Pumps, Vacuum: 6 CFM. to 115 CFM.
Pumps, Vacuum: Nash Hytor H-4 and AL-6.
Purifier, Oil: De Laval model 600, 2 hp.
Reactor: Iron, 200 gal., jacketed.
Scales: Printweigh 500, 1000 and 2000 lb., dial, hopper, batch type.
Screens: Robell 20x48", Rotex 40x84".
Tanks: Stainless steel, new and used.

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- Krenz S.S. 6' x 16', Coil type
- 2 Effect S.S. 480 sq ft. Side Heaters

MIXERS
- Baker-Perkins double sigma, size 16½DIM
- Diamond sigma arm Mixers, 125 gal cap (2)
- Day Ribbon Blenders, Size B, C, & D (3)
- 1 ton Conical, 3 HP motor
- Simpson Size O, Style M Mixmuller, 5 HP
- Reid 5 bbl double arm, 10 HP

SCREENS
- Rotex #42, two deck, 40" x 84", 3 HP
- Rotex #82, two deck, 40" x 120", 5 HP
- Sweyco 48" dia 4 deck, 10 extra screens
- Rotex #41, 40" x 80", single deck 3 HP
- Smithway 40" x 90', single deck
- Tyler-Summer, 3' x 5' triple deck
- Selectro S.S. 3' x 6' double deck
- Simplicity 3' x 6' triple deck

MISCELLANEOUS
- Karbate Heat Exchanger, 366.72 sq ft 2 pass
- Eimco 8' x 8' rotary cont. Filter. Pract new
- Sweetland #12 Filter, 4" centers
- Moore Ball Mill 4' x 3', 10 HP motor
- Sharples Super-D-Cantor PY-14 S.S.
- Bird cont. Centrifuge, 36" x 72" monel-steel
- Oliver Precoat Filter, 5'3" x 8' type 316 S.S.
- Devine Vacuum Shelf Dryer 5 shelves S.S. trays

PLEASE NOTE
- Space limitations make it impossible to list all of the more than 10,000 items we have available—
- The largest stock on the West Coast. Please send your individual inquiry. We have the right machine for your job!

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Double Effect S.S. Evaporator.
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32"x52" & 36"x84" Double Drum Dryers.
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REACTOR—75 gal. SS Jktd & Agtd, U69 Vessel
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KETTLES & TANKS
Fabricated to Your Specifications
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2—150 gallon STAINLESS STEEL Kettles, 100# jacket pressure.

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located in Delaware.

1—Traylor Rotary Kiln 10'6" dia. x 112' long
1—Allis Chalmers 6' dia. x 16' long steel lined continuous Ball Mill
3—Patterson & Abbe 4'6" dia. x 12' cont. Pebble Mills
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3—Charlotte Colloid Mills, model #50, 75 HP motor
1—Bird Centrifuge 36" x 50".
10—Muffle Furnaces 18" dia. x 8'6" long rotary chrome nickel alloy tubes
1—30" C.I. Filter, 46 ch.
2—24" Sperry Recessed Plate Filters, 33 plates
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Lot of Miscel. Items—Wood Tanks, Steel Tanks, Crushers, Bins, Pumps, Conveyor, etc.

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Built 1946-47—Never Used

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LOUISVILLE ROTARY STEAM TUBE DRYER 6' x 40'

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1st eff—Forced circ.—500 sq. ft.
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36" dia. Copper Beer Still and Bubble Cap Columns with condensers
8800 gal. Pressure Cooker with agitator and vacuum pump
Dracco Pneumatic Grain Unloader, 250 bu. hr.
10 Copper Tanks—500 to 2000 gal.
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Pumps—Grain equip., etc.

2—S. S. ½ gal. Autoclaves, 2000# pr., Ag.
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1—A.T.&M. 48" Susp. Centrifugal, Perf., St. St. Fume Tight
1—Bird 48" Susp. Centrifugal, Perf., T347 St. St.
2—785 sq. ft. T316 St. St. Heat Exchangers
1—Stokes 3' dia. x 15' L Jacketed Rotary Vacuum Dryer
4—Atm. Double Drum Dryers, 22" x 38", 42" x 120"
1—Feinc Rot. Vac. Filter, string disch., encl. housing, 4'6" dia. x 6', alum.
1—Oliver Precoat Rot. Vac. Filter, encl. housing, 5'3" x 3', rubber cov.
6—Stokes & Kux Pellet Presses
1—B-P #14 JEM Univ. Jktd. Mixer, Vac. Cov. 50 HP, 50 gal. work. cap.
2—W & P 100 gal. Sigma Blade Jktd. Mixer
1—Day 10 gal. St. St. Sigma Blade Jktd. Mixer
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20—Alum. Tanks—500 to 4000 gal.
30—Welded Steel Tanks—4300 to 15,000 gal.
30—Agitator Drives 3 HP to 40 HP

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Send for Information on our RENTAL-PURCHASE Plan

- ★ 750 Gal. Monel Jacketed Reactor with monel agitator with motor
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- ★ Stainless Steel Baker Perkins Lab. Mixer; "6x12"x10"
- ★ Stainless Steel Distillation Columns; 8"x10'x15' and 19'
- ★ Mojonnier Stainless Steel Vacuum Pan; 3'x10' with Calandria
- ★ Stokes Rotary Vacuum Dryer Steam Jacketed; 30"x10' with Condenser
- ★ Shriver Stainless Steel Filter Press 18"x18" closed delivery
- ★ Three Stainless Steel Vacuum Filters; 35"x35"
- ★ Three Stainless Steel Vacuum Receivers; 14½"x47"x24½"x71"
- ★ Stainless Steel Premier Colloid Mills; U 3; 6" with 15 H.P. motors
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- ★ Stainless Heavy Duty Agitators 42" Shafts; 28" dia. Props; 5 HP Gear Motors
- ★ Abbe & International Pebble Mills 8'x8'; 6'x8' and other sizes

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Latest type Metallurgical and Chemical Equipment

EXCELLENT CONDITION

Hardinge Conical Ball Mill 10' x 48"
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Dorr Type A Thickeners
Allis-Chalmers type 222 Gyratory Crusher
Link Belt Screw & Belt Conveyors
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Research Corp. Electrostatic Precipitator

The above items include all auxiliary equipment with individual motor and control 220/440/3/60. The equipment may be inspected on foundations.

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2—Duriron Pumps 140 gpm @ 40'.
2—Heat Exchangers, 6.6., 9 sq. ft. surface.
1—Stainless Tank #430 Chrome, vert. 7'x10' deep.
20—Jacketed Kettles—Stainless, Copper, Aluminum.
1—Day Mixer, steam jacketed, 50 gal. Sigma Blade.
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1—Copper Evaporator, steam jacketed, 9'1"x3'9".
60—New Pressure Cookers, 18"x18" & 24"x28".
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1—Jeffrey Vibrating Conveyor 15' lg. 12" wide.
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1—Ribbon type Mixer, steam jacketed.
3—New Drum Rollers.
2—Nash Air Compressors, Type AL-623.
1—Manton Gaulin Stainless Homogenizer, 125 gph.
1—Shriver 18" Aluminum Filter 9-plates 9-frames.
1—Rotary Dryer direct fired 54"x30'6".
1—Kennedy-Van Saun Rotary Dryer, 4'x40'.
Davenport Rotary Steam Tube Dryer, 6'x36'.
1—Gruendler Hammer Mill, 10 H. P.—new.
2—Ransome Rotating Drum Mixers 9' dia. x 11'x8".
1—#316 stainless Reactor, 265 gals. cap. jacketed.
Abbe Pebble & Tube Mill, 5'x22'—Burr-Stone Lined.
1—Patterson Ball Mill, porcelain lined, 17"x27".
1—Patterson Ball Mill 42"x36" jacketed.
3—Dopp Kettles with agitators, 600 gal. cap.
1—Sparkler S.S. Filter 18-D-6.
2—Large Steam Jacketed Horizontal Mixers.
Robinson Pulverizer #20, with 2 motors 10 HP each.
Robinson Ribbon Type Mixer, 30"x10"—like new.
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2—Crystallizers—10' long.
2—500 ton Hydraulic Presses.
3—3,000 gal. Jacketed Kettles with Turbo Agitators.
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Swenson Continuous Vacuum Cooling Crystallizer of Rubber Lined Steel and S.S. Construction. Vacuum Cooling Body 3'-6" x 11'-0". Crystallizing Body 5'-0" x 10'-0". W/Piping, Circulating and Vacuum Pumps w/Controls.

Feinc 6'-0" dia. Horiz. Type 304 Stainless Steel Filter w/Vacuum Pump.

Nash H-6 Vacuum Pump.

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Shriver 30" Four Eyes, Closed Delivery 18 Chambers C.I. Filter Press—Hydro Closure.

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Two 10,000 Gal. Steel Mixing Tanks w/Turbo Agitators and Drives.

Kettles, Sifters, Tanks, etc.

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BLOWERS - EJHAUSTERS - 4500 - 6500 - 10,000 cfm and 6 New Sturtevant 35,000 cfm design 7 size 115.
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BALL MILLS - 5½ x 22, manganese liners - 200 HP motor.
HARDINGE MILLS - 3'x8" - 5'x36" (w/ classifier) 6x22 - 7x48 10'x48" - all with motor drives.
MIXERS - Robinson Double trough 15"x10' - W & P 50 gallon double sigma - Simpson 1½ - Lancaster 4 EAG w/ motors.
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Dryers: 4'x20', 6'x24', 5'x50', 6'x60' & 30"x60'

MISCELLANEOUS EQUIPMENT
Hammer Mills: Jeffrey 36x24B. 75 H.P. Motor.
40'x30' Dorr 3 Tray 4 Compartment Thickener.
6'x22", 3'x7', 5'x18', 7'x6', 6'x12', 10'x4' Ball Mills
4'x7', 6'x12', 5'x10', 5'x14', 3'x10' Rod Mills.
3—Dorr Thickeners A-26' Dia. 10' Deep.
2—Dorr Turret Bowl 3'x24', 10"x10" Classifiers.
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PROCTOR AND SCHWARTZ DRYERS

One 8 ft. wide by 37 ft. centers, one 8 ft. by 48 ft. centers.

Also 3 Ajax Water Heaters, 2,000,000 btu.

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PROCESS EQUIPMENT

BOILERS—304 HP Kewanee Firebox, Model 590, 125 PSI, ASME, oil burners, soot blowers.
150 HP, HRT Boilers, 150 PSI, gas fired, ASME.
CENTRIFUGES—40" Steel & SS (2).
Sharples Nozljector, #DH2, SS.
Bird 40" Susp., perf. basket, SS 347, 25/6.2 HP.
DRYERS—Rotary, Vac.—30"x8', 5'x30', 7'x20'.
Steam Tube—6'x35', Louisville.
HEAT EXCHANGERS—160 sq. ft. copper tubes, steel shell.
1000 sq. ft. Everdur tubes, steel shell.
3300 sq. ft. 2 pass, steel shell.
KILNS—3'x25', 4'x30', 5'x30', 5'x67', 7'x45', 7'x60', 7'x120', 7'x160', 8'x125', 9'x80'.
MILLS—Raymond, 5 roll, 50" high side.
Raymond, 3 roll, 42" high side.
Raymond #1 Automatic.
Williams 28"x24" heavy duty.
MIXER—300 gal. Baker-Perkins SS, 18-DIM, double arm, 30 HP motor & starter.
REACTORS—3000 gal. SS jktd. & coiled; 980 gal. steel jktd. & agit.; 300 gal. SS jktd. & agit.

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HEAT EXCHANGERS—Tulsa, 16 to 1530 sq. ft., brass and steel tubes.
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PRESSURE TANKS—6400 to 25000 gal.
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STORAGE TANKS—100 to 8800 gal.
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ROTARY-POSITIVE BLOWERS

MAKE	SIZE	TYPE	Max. Press.	Max. CFM
Roots-Conn	20 x 60	SF	2	6150
Roots-Conn	22	NAS	3	19
Sutorbilt	3L	Cal.	3	69
Sutorbilt	4L	Cal.	3	132
Roots-Conn	47	AF	3	124
Sutorbilt	5L	Cal.	3	249
Roots-Conn	59	AF	3	205
Roots-Conn	615	AF	3	360
Roots-Conn	717	AF	3	650
Sutorbilt	14 x 36	XB	3	3070
Roots-Conn	8 x 20	RCR	3.5	955
Sutorbilt	18 x 42	XB	4	5320
Roots-Conn	22 x 36	RCD	5	5530
Roots-Conn	33	AF	5	38
Roots-Conn	44	AF	5	98
Roots-Conn	67	AF	5	164
Roots-Conn	710	AF	5	350
Roots-Conn	14 x 36	RCR	5	3580
Roots-Conn	16 x 24	RCD	5	2515
Roots-Conn	10 x 18	RCD	6	805
Sutorbilt	3M	Cal.	6	31
Sutorbilt	4M	Cal.	6	76
Sutorbilt	5M	Cal.	6	115
Sutorbilt	6M	Cal.	6	189
Roots-Conn	10 x 12	RCS	7	614
Roots-Conn	53	AF	7	70
Roots-Conn	76	AF	7	200
Sutorbilt	4H	Cal.	10	39
Sutorbilt	5H	Cal.	10	66
Roots-Conn	65	AF	10	115
Sutorbilt	6H	Cal.	10	128
Sutorbilt	8H	Cal.	10	272
Roots-Conn	10 x 10	RCR	10	616
Roots-Conn	10 x 7½	RCD	10	440
Roots-Conn	18 x 14	RCDH	10	2100
Roots-Conn	24 x 23	RCDH	10	8610
Roots-Conn	32 x 32	RCDH	10	14950

TURBO BLOWERS

Stock No.	Make	Size	HP	Vol.	Press. -oz.
1227	General Blower	800¾	¾	180	8
1501	Spencer	Special	1	92	10
879	Sturtevant	2	1	215	10
1226	Fisher	F15	1	300	10
880	Buffalo	4OR	5	750	10
1497	Eclipse	2-1	1	150	10.5
1473	Buffalo	3RE	7½	800	12
1659	Buffalo	5E	2	300	12
1200	Spencer	0755	5	850	12
546	Mohr	505	5	875	12
1587	Mohr	501½	1½	170	14
1495	Eclipse	2-1½	1½	100	15
769	Spencer	1001	1	110	16
1556	General Blower	1610	10	1300	16
1201	Spencer	1007	7½	1000	16
1202	Spencer	1005	5	600	16
1203	Spencer	1005	5	600	16
361	N. American	1716E	7½	1100	16
1532	Buffalo	4RE	10	800	24
1569	Sturtevant	170-225	60	10100	13
1601	N. American	1716-A	1	90	16
1605	Spencer	1005	5	635	16
368	Eclipse Fuel	6819	10	1200	16
689	Spencer	1010-A	10	1500	16
1601	General Blower	1630	30	3600	16
	Spencer	1015	15	1850	16
	Spencer	1007	7½	1000	16
881	N. American	15G2	5	700	19
1494	Power & Engineering	2010	10	1150	20
1031	Spencer	1215	15	1675	20
1529	Ingersoll Rand	F8377	150	15000	20
1530	Ingersoll Rand	F8377	85	10500	20
1513	Spencer	1230	30	3400	20
2410	Spencer	1510	10	950	24
2415	Spencer	1515-H	15	1425	24
1500	General Blower	2425-1	25	2500	24
3220	Spencer	2020	20	1300	32
693	Allen Billmeyer	D-6	7½	275	48
1000	Spencer	Special	200	8200	48
478	Allen Billmeyer	DA8	15	225	96
244	Allen Billmeyer	ED5B5	30	410	96

CENTRIFUGAL FANS

MAKE	SIZE	TYPE	Wheel Diam.	Inlet
American	11	FH	65¾	73¼
American	9	AHS	53¾	61
Gen. Blower	9	FC	54	57
Buffalo	9	LLD	55	56
American	7	HS	44	50½
Clarage	3½	W	42¾	44
Bayley	8	I	40	41
New York	39	ME	39	43
New York	36	ME	36	39¾
American	500	HS	30	32
Clarage	2¼	W	29¾	30½
Sturtevant	6	Des. 3	27	27½
Buffalo	4½	LL	26½	28
American	2	Sirrocco	15½	12
Buffalo	2	LL	12	12¾

STEEL PLATE EXHAUSTERS

MAKE	SIZE	TYPE	Wheel Diam.	Inlet Diam
Sturtevant	100	Des. 3	72¼	38
Sturtevant	70	Des. 3	49½	26
American	80	ELS	48½	29½
American	70	ELS	42¾	25¼
American	55	ELS	36¾	23
Sturtevant	50	Des. 3	36	19
New York	33	GI	33	21¼
Buffalo	45	MW	32	19½
American	50	ELS	31	18½
Gen. Blower	45	MX	27	18¾
American	35	E	23	15
Sturtevant	30	Des. 2	18	11
American	3	VRV	13	7
American	3	V	12	7
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Peerless	9	PW	9	5
Allington-Curtiss	70		56¼	34
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1—Stainless Steel Jacketed Kettle, 100 gal capacity, with Anchor Type Agitator and Drive, 125# jacket pressure.
2—Koven 13 gal. Stainless Steel Jacketed Kettles.
1—Patterson Stainless Steel Vacuum Reactor, 50 gal.
1—Buflovak Type 347 Stainless Steel Rotary Vacuum Dryer, 5' x 20'.
2—Buflovak Double Drum Dryers, 24" x 36".
1—Buflovak Double Drum Stainless Steel Laboratory Dryer, 6" x 9".
1—Link Belt Steel Roto Louvre Dryers, 7½' x 20'.
1—Stokes Rotary Vacuum Dryer, 3' x 12'.
1—Vulcan Rotary Kiln, 7' x 120'.
1—Buflovak Double Drum Dryer, 32" x 90".
1—Louisville Steam Tube Dryer, 6' x 50'.
1—Buflovak Double Door Vacuum Shelf Dryer, 20 shelves each.
1—Louisville Experimental Laboratory Dryer, 12" x 7½'.
9—Devine Vacuum Shelf Dryers, 5, 9 and shelves.
1—Buflovak 24" x 24" Double Drum Dryer.

FILTERS

2—Shriver 24" x 24" Cast Iron Plate and Frame Filter Press, 2 chambers each.
1—Sweetland #2 Stainless Steel Filter.
1—Sparkler Type 316 Stainless Steel Filter, Model 33 D 7.
1—Bird Young Filter, 4' x 2'.
2—Bird Type 316 Stainless Steel Filters, 18" x 24".
1—Shriver 42" x 42" C.I., P.F. Filter Press, 60 chamber, open delivery with hydraulic closing.
1—Sperry Aluminum Plate & Frame Filter Press, 42" x 42", Closed Delivery, 3" Frames, 35 Chambers.
1—Bird 24" Monel Screen Type Centrifugal Filter.
1—Sperry 42" C I Plate and Frame Filter Press, 16 Chambers, Closed Delivery.

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1—Tolhurst Solid Curb Centrifuge 20" Perforated Basket.
1—Tolhurst Stainless Steel 26" Solid Curb Centrifuge with Perforated Basket.
1—Fletcher Stainless Steel Suspended Type Centrifuge, 40" Perforated Basket.
2—A. T. & M. Stainless Steel Susp. Centrifuges, 48" Imperforated Baskets.
1—Sharples Type 316 S.S. Super-D-Hydrator, Model No. C-20.

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1—Baker Perkins Stainless Steel Dispersion Mixer, Size 15, Type VUMM, 100 Gals.
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1—Baker-Perkins Steel Jacketed Double Arm Sigma Blades Mixer, 200 gallon working capacity. Year built 1948.
1—Gemco Double Cone 8" Blender.
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3—Open Top Type 316 Stainless Steel Tanks, 500 gallons each.
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7—Buflovak Single Door Vacuum Shelf Dryers, 20 shelves each.
1—Devine Double Door Vacuum Shelf Dryer, 13 shelves.

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1—Mikro #3W Pulverizer.
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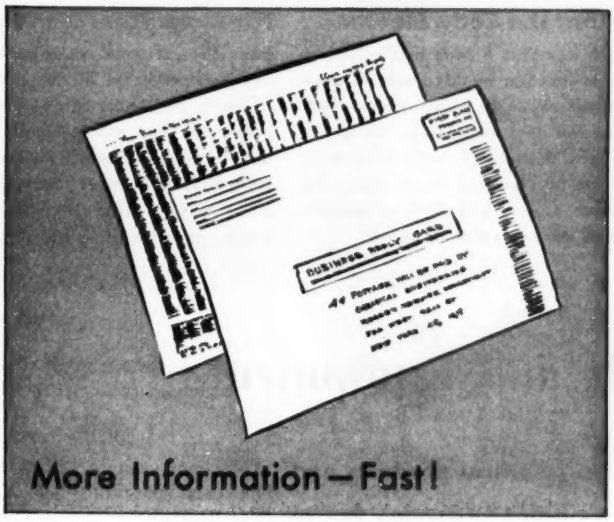

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Here's your complete index to the chemicals, materials, equipment and services advertised in this issue, announced in the Product News and Process Equipment News departments, or listed in this issue's Guide to Technical Literature within this Reader Service section.

What the Code Means . . .

Each item has a code that's the key to its location in this issue. The numerals show the page where you'll find the item mentioned. The letters L (left), R (right), T (top), B (bottom) locate ad positions on the page; the letters a, b, c and A, B, C identify items on a page or in an ad.

For More Information . . .

You can get more information on any product listed in this directory by using the Reader Service postcard inside the back cover. Simply circle the item's code number on the postcard, then mail to us. Answers will come to you direct from the companies manufacturing the products.

Index to Chemicals and Equipment

Find it tough to keep up with chemical products and equipment? You can use this master index as a quick way to spot exactly what's in each issue on any particular item.

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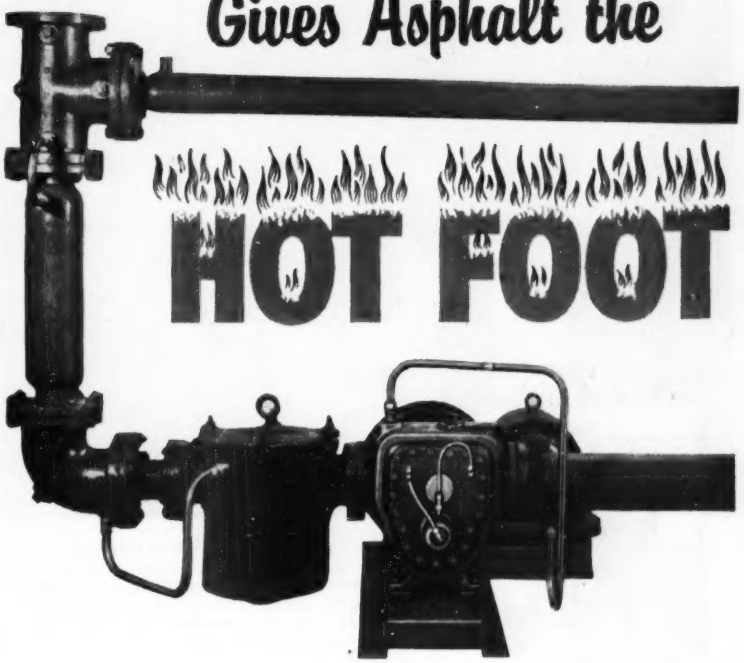

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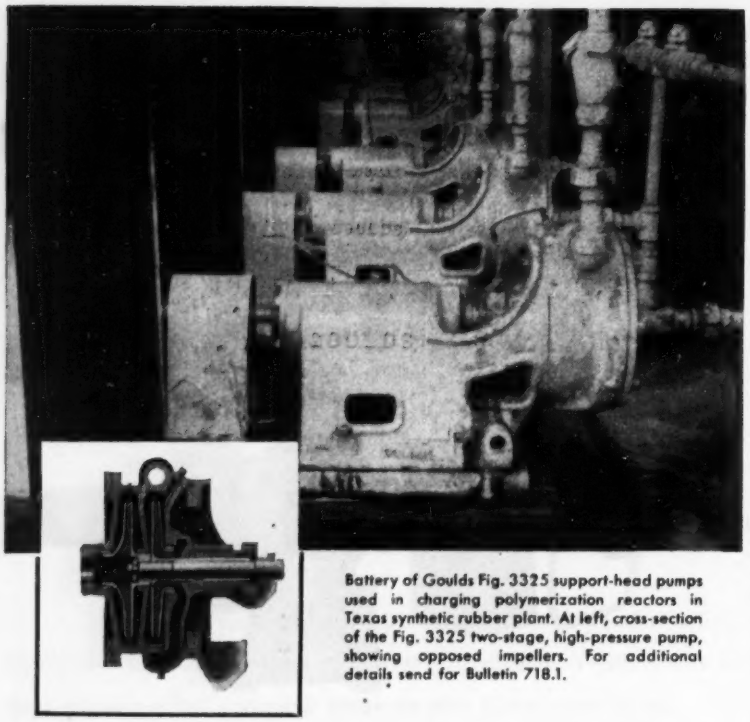

Battery of Goulds Fig. 3325 support-head pumps used in charging polymerization reactors in Texas synthetic rubber plant. At left, cross-section of the Fig. 3325 two-stage, high-pressure pump, showing opposed impellers. For additional details send for Bulletin 718.1.

How Synthetic Rubber Plant Handles Highly Flammable Liquids

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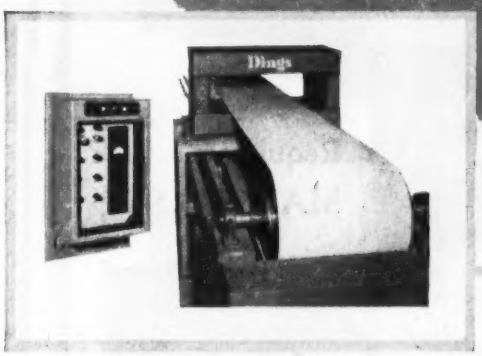

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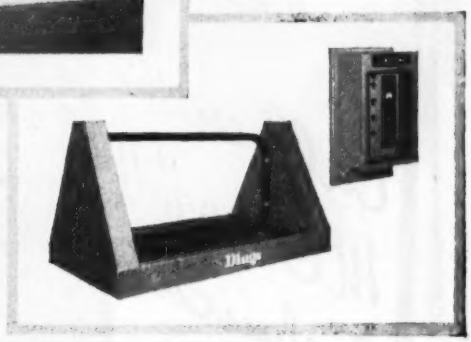

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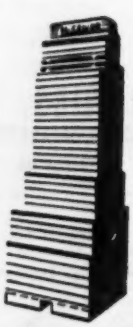

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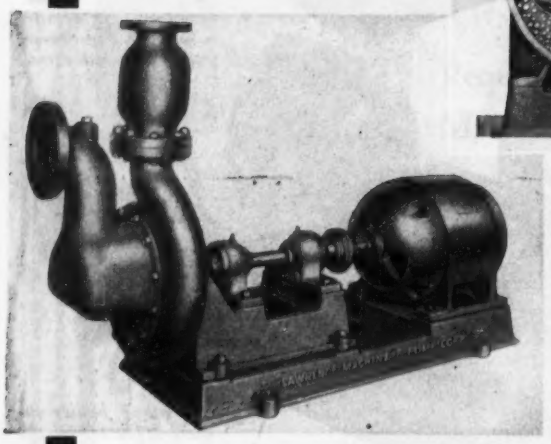
(Right) Lawrence Self-Priming Pump exhausting air during priming.



(Left) Lawrence Heavy Duty Self-Priming Chemical Pump.

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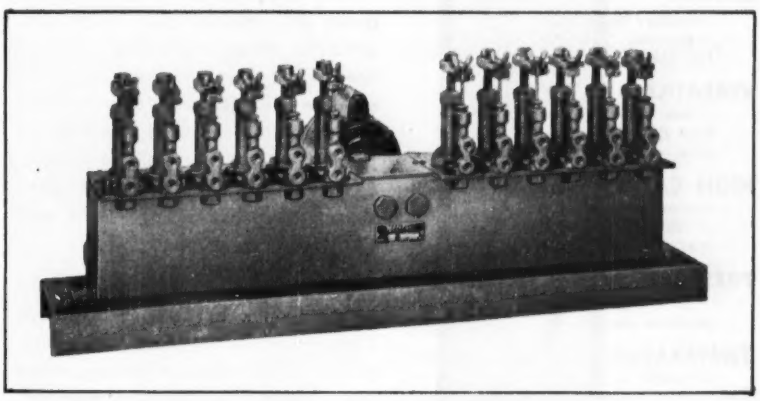

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Flashback

To make sure that you don't miss any news that could help you with your job, Chemical Engineering is doing a double take for you. The index below repeats the editorial listings only on chemicals, equipment and services featured last month in New Equipment and New Products. Use the postcard (p. 427) for more information on any item.

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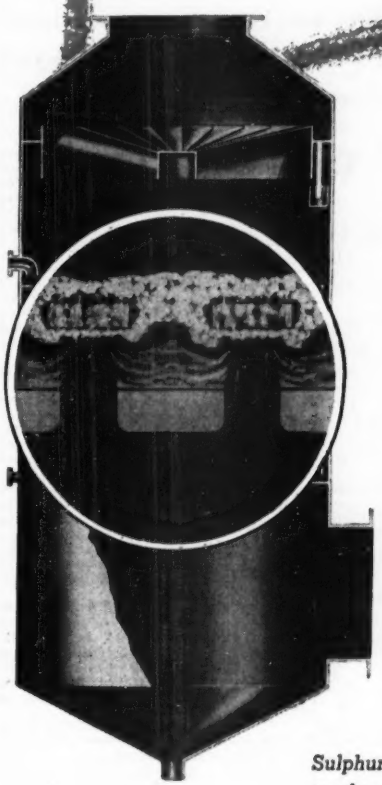

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Guide to Technical Literature

Want to build up your files and keep them up-to-date? This comprehensive guide to available literature will help you do just that. They're yours—free—for the asking.

Chemicals

Acetoacetarylamides.....White, crystalline, flaky solids resembling ethyl acetoacetate in chemical reactivity. Covers data on physical properties, physiological properties, applications, etc. 4 p. No. F-8259.
404A Carbide & Carbon Chem. Co.

Acid, b-Benzoyl Acrylic.....Phenyl group & carboxyl group at opposite ends . . . the keto group & double bond in the middle—four points of reactivity for your own exploration. Data in Technical Bulletin I-6.
404B National Aniline Div.

Acid, Fumaric.....Data on use in coatings & polyester resins. Covers such subjects as chemical reactions, fumaric acid in drying oils, in tall oil varnishes, in steam-set inks, & in polyester resins. Bulletin O-115.
14-5h Monsanto Chem. Co.

Acid, Fumaric.....Non-hygroscopic — flows freely...low-order of toxicity ...non-corrosive — these properties make it ideal for alkyd resins, rosin adducts, polyesters. Offers full details in Technical Bulletin No. 46.
88 Chas. Pfizer & Co.

Acid, Oxalic.....Long recognized for its consistently high purity...a clear, colorless product which assays a minimum of 99.2% $C_2H_2O_4 \cdot 2H_2O$. In coarse & fine crystal forms to meet every need. Data & samples.
404C General Chem. Div.

Acids, Fatty.....High-purity Hystrene hard saturated fatty acids are now supplied in labor-saving palletized units of forty bags each. New Folder lists complete specifications & describes new shipping method.
404D Atlas Powder Co.

Acrylonitrile.....Furnishes a 44-by-34 inch comprehensive wall chart which shows chemical methods for converting acrylonitrile into more than 100 derivatives. Literature summary of potential uses for derivatives.
404E Monsanto Chem. Co.

Acrylonitrile.....Reactions of acrylonitrile and its major uses are described. Includes properties, constant-boiling mixtures, specifications, and shipping information. Technical Bulletin No. F-8381.
404F Carbide & Carbon Chem. Co.

Alcohol, Ethyl.....Features ethyl alcohol of the highest quality, surpassing all Federal & commercial specifications for purity. Catalog covers complete line of solvents, intermediates, resins. No. SC:53-18.
404G Shell Chem. Corp.

n-Alkenes.....Company announces the pilot plant production of a series of n-alkenes—new chemical intermediates made from fatty acids. Physical properties and other detailed information in Bulletin No. HC-1.
404H Armour & Co.

Alkyl Aryl Sodium Sulfonate.....Covers pertinent data on availability; solubility in water, organic solvents, acids, alkalies, salts and electrolytes; surface tension; stability in acids, alkalies, salts, etc.
404I Petrochemicals Co.

Alkyl Sodium Compounds.....Alkyl sodium compounds—such as amylsodium and phenylsodium—offer many versatile applications. Describes properties, preparation, typical reactions, etc. in new, detailed Fact Sheet.
404J Ethyl Corp.

Aluminum Chloride, Anhydrous.....Offers 4 sizes for almost every processing need: fine grind; extra fine grind; coarse grind; coarse screened. Details in Data Sheet. Bulletin 100 covers products and services.
51 Hooker Electrochem. Co.

Benthal.....Used in production of short and medium oil alkyd resins to control viscosity. Acts as molecular chain stopper. Improves resin durability, alkali and water resistance and film gloss. New Bulletin.
14-5b Monsanto Chem. Co.

Benzenes, Chlorinated.....Offers a new, 16 p. Technical Handbook describing chlorinated benzenes. Includes derivative charts, end uses, property and solubility tables and toxicity and handling precautions.
404K Dow Chem. Co.

Calcium Lignosulfonate..... Presents new Folder describing Toranil, a desugared calcium lignosulfonate. Covers physical & chemical characteristics, together with a list of present uses & suggested applications.
404L Lake States Yeast Corp.

Catalysts.....Manufactures to specification dozens of catalysts for numerous different and complex manufacturing processes—hydroforming, alkylation, dehydrogenation, cyclization, dehydration, isomerization, etc.
12 Harshaw Chem. Co.

Chemicals, Organic.....Bulletin designed to present in quick reference form a listing of typical industrial applications, & general properties of two reactive chemical products derived from redwood bark. No. C-28-5.
404M Pacific Lumber Co.

b-(o-Chloroanilino) Propionitrile..... Soluble in ethanol, ether, acetone, benzene & chloroform. Insoluble in water, hexane. Typical nitrile, hydrolyzable to acid derivatives. Basic nitrogen atom, forms salts.
14-5e Monsanto Chem. Co.

Defoamers.....For more efficient foam control. Versatile defoamers save space now wasted on foam, cut the processing time, eliminate waste & fire hazard of overflowing foam, etc. Offers complete details.
R343 Dow Corning Corp.

trans-1,2-Dibenzoyl Ethylene.....With its reactive double bond & its two carbonyl & phenyl groups, diketone molecule should be widely useful in compounding resins, pharmaceuticals, etc. Technical Bulletin I-3.
404N National Aniline Div.

Di-tert-Butyl-p-Cresol..... Toxicological information, descriptions of chemical reactions, etc. on product proven effective as antioxidant for fatty foods & hydrocarbon materials. Technical Bulletin No. C-4-115.
404O Koppers Co.

Di-tert-Butyl-p-Cresol.....Information in non-technical language on use of "dbpc" antioxidant in food, plastics, rubber, insulating oils, petroleum fuels, lubricants and waxes, etc. Illustrated Bulletin No. C-4-197.
404P Koppers Co.

Emulsifiers.....Company line of emulsifiers improves formulas for self-polishing waxes. Industrial applications described in "A Guide to Formulation of Industrial Emulsions with Atlas Surfactants."
404Q Atlas Powder Co.

Esters.....Furnishes descriptive booklet, "Esters by Glyco," containing application & property information on a wide range of products. Data on monoglycerides, glycol and polyglycol esters, etc.
404R Glyco Products Co.

Flavors.....20 p. illustrated Flavor Catalog fully describes more than 30 separate flavor groups embracing a total of over 700 different flavors. Distribution limited to those who buy in wholesale quantities.
405A Fritzsche Bros.

Fumaryl Chloride.....Interesting molecular structure with a reactive double bond & 2 acyl halide groups that should be a versatile building block in organic syntheses. Information in Technical Bulletin I-7.
405B National Aniline Div.

Furfural.....Petroleum refiners, resin makers, chemical producers, abrasive wheel manufacturers rely on furfural for performance...uniform purity... low cost...unfailing availability. Uses in Bulletin 204.
407 Quaker Oats Co.

Glycerine.....Numerous properties make it preferable for toilet preparation. Safe for use in pharmaceuticals. Offers complete information in detailed booklet, "Why Glycerine for Drugs and Cosmetics?"
78 Glycerine Producers' Assoc.

Glycol Dibenzoate Esters.....Announces a new series of glycol dibenzoate esters, each with special properties that may improve your product or processing. Offers experimental samples & technical information.
405C Tennessee Products & Chem.

Intermediates.....Company furnishes detailed information on monomethylamine, dimethylamine, trimethylamine. This versatile trio represents the most economical source of the amine group. Technical Data Sheet.
405D Commercial Solvents Corp.

Isopropylamine.....The lowest molecular weight alkyl amine which can be supplied in anhydrous form without the use of special pressure containers. Detailed technical information and samples available on request.
405E Sharples Chem.

Lubricants, Anti-Corrosion.....Bulletin designed to offer a detailed list of correct lubricants for many specific applications within a wide range of industries, under all types of operating conditions. No. BK-20.
405F Keystone Lubricating Co.

Lubricants, Synthetic.....Ucon synthetic lubricants increase efficiency of power recovery engines...because of resistance to sludging & carbonization. Technical Bulletins on industrial applications.
405G Carbide & Carbon Chem. Co.

Methanol.....Presents a detailed, 16 p. Booklet on synthetic methanol. Valuable information on uses, physical properties, shipping data, specifications, and constant-boiling mixtures. Booklet F-8141.
405H Carbide & Carbon Chem. Co.

Methyl Glucoside.....A new cyclic polyol —white, crystalline, and non-hygroscopic. It is now available in 100 pound, multiwall paper bags. Company makes available technical literature and samples upon request.
405I Corn Products Refining Co.

N-Methylcyclohexylamine Technical..... Water-white liquid with a specific gravity of 0.86 at 20°C. It is soluble in both alcohol & ether but only slightly soluble in water. Offers complete information.
405J E. I. du Pont de Nemours.

o-Nitrobenzenesulfenyl Chloride.....Soluble in benzene, acetic acid, & chloroform; slightly soluble in ether & carbon tetrachloride. In general, it undergoes reactions similar to acid chlorides. Data Sheet.
14-5d Monsanto Chem. Co.

Nitrogen Fertilizer Solutions.....60 p. covers nitrogen fertilizer solutions for direct application. Includes advantages & characteristics of nitrogen solutions, recommended crop applications, etc. Illustrated.
405K Allied Chem. & Dye Corp.

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When crystalline or powdered chemicals become caked or agglomerated due to atmospheric conditions or pack down in shipment, it is necessary to restore them to their original form without grinding the crystals to dust. A Prater power screener is ideal for smoothing out such materials because its action is gentle enough to cause no grinding or attrition which would destroy the crystalline structure.

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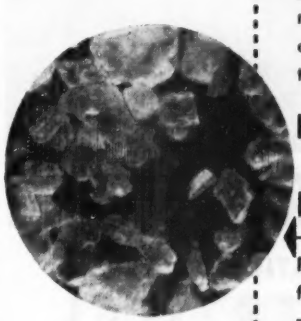

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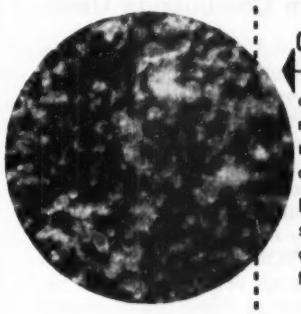

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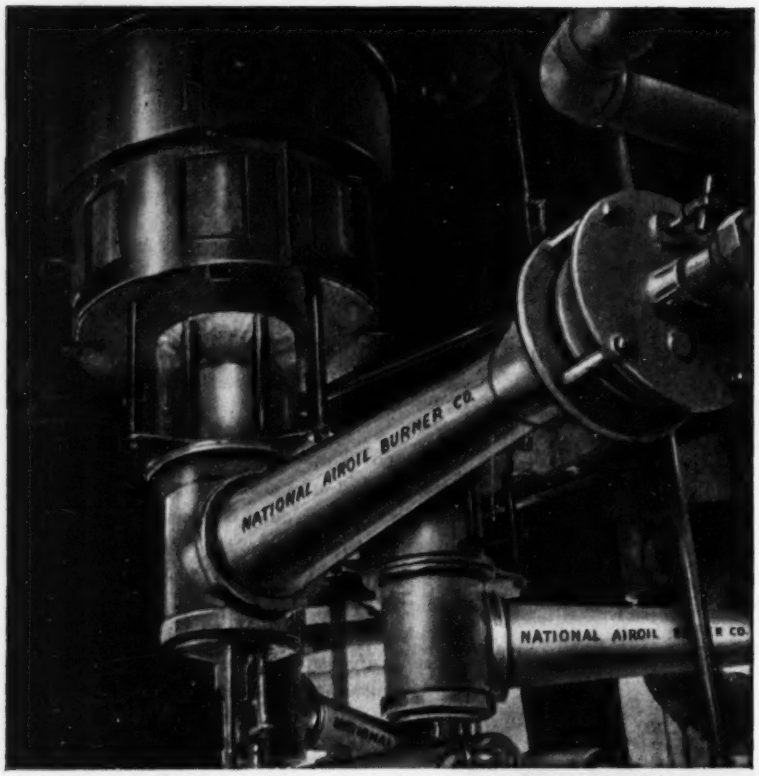

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LITERATURE . . .

Oils, Essential.....Company furnishes their latest 36 p. Catalog covering product listings, descriptive information, latest prices of oils, oleoresins, aromatic chemicals & specialties & certified colors.
406A — Dodge & Olcott.

Phenyls & Biphenyls, Chlorinated..... Acting as an extreme pressure lubricant base...Aroclors possess many advantages: stability; nonvolatile; nonoxidizing; etc. Complete data on uses covered in Bulletin P-128.
14-5f — Monsanto Chem. Co.

Pigments, Iron Oxide.....Reduce grinding and dipersing time in paints and allied products as much as 75%. Physical and chemical specifications and a list of suggested applications. VVF Tech Report.
331 — C. K. Williams & Co.

Plasticizers.....Presents completely revised Bulletin which covers sections on chemical and physical properties, specifications, resin compatibility and performance characteristics. Santicizer 141—Bulletin O-89.
14-5g — Monsanto Chem. Co.

Potassium Cyanide.....Data on a new form of potassium cyanide, known as CyaNodes. Formed by cast process—are dust-free, sulfur-free, non-flaking. High in purity, dissolve very quickly, and safer to handle.
406B — Kraft Chem. Co.

Powders, Diatomite.....Celite inert diatomite powders provide more potent insecticide dusts at low cost. Covers details of advantages and properties of insecticide carriers, in fully illustrated, 4 p. Folder.
406C — Johns-Manville.

Preservatives.....Offer many advantages: high effectiveness against molds and bacteria; extremely low toxicity confirmed by extensive tests; non-irritating to skin; colorless, odorless; etc. Technical Bulletin.
406D — Heyden Chem. Corp.

Preservatives.....Copper 8-quinolinate, technical is most effective commercial preservative yet developed for controlling rot and mildew in textile and related fields. Booklet on Milmer 1 offers full details.
14-5a — Monsanto Chem. Co.

Propylene Oxide.....Features usage in the production of petroleum de-emulsifiers and textile lubricants. Also an effective stabilizer in formulation of products from resins that contain chlorine. Full data in F-8485.
145 — Carbide & Carbon Chem. Co.

Resins.....New, 36 p. Technical Booklet includes a wide range of data relative to the use of Vinsol resin as a low-cost component of Buna-N, vinyl and other type adhesives. Covers properties and modifications.
406E — Hercules Powder Co.

Resins, Para-Coumarone-Indene.....Provides complete information on line of Piccoumaron resins. Included are pertinent details on chemical properties, physical properties, solubility, compatibilities, etc.
406F — Pennsylvania Industrial Chem.

Resins, Polystyrene Cation Exchange..... Describes in detail the characteristics of this new type of polystyrene cation resin, with operating data. Leaflet covers capacity performance, salt efficiency, leakage, etc.
406G — Chemical Process Co.

Resins, Sorbitol.....Sorbitol provides specific advantages of quality and economy in the formulation of certain resins used in protective finishes. Descriptive booklet includes physical characteristics.
406H — Atlas Powder Co.

Sequestering Agents.....Outstanding sequestering or chelating agents capable of controlling, by deionization, undesirable di- or tri-valent metal ions in aqueous solution. Offers literature and sample.
406I — Antara Chem. Div.

Sodium, Metallic.....May be employed as a molten liquid...as bricks...as a dispersion in an inert hydrocarbon ...or as a coating on free flowing inert solid particles. Booklets offer complete information.
86 U. S. Industrial Chem. Co.

Sorbitol.....Offers detailed 21 p. Booklet which covers the characteristics and properties of sorbitol of interest to food processors and shows under what conditions sorbitol can be used most advantageously.
407A Atlas Powder Co.

Spheres, Phenolic Resin.....Offers technical performance data on Microballoons...a new method of reducing evaporation of crude oil in cone-roof tanks. Covers properties & methods of installation. Illustrated.
407B Bakelite Co.

Styrene Monomer.....Lists products obtained from this basic chemical, & their applications. Include synthetic rubber, polystyrene, styrene butadiene latices, polyester resins, etc. 23 p. No. C-4-198.
407C Koppers Co.

Styrene Monomer.....Company also makes available supplemental information of a more detailed technical nature—such as chemical reactions, methods of handling and analysis. Technical Bulletin No. C-4-119.
407D Koppers Co.

Surface Active Agents.....A new text on application and handling of Aerosol has been prepared as a guide to efficient and economical use of these powerful surface active agents. Presents complete information.
407E American Cyanamid Co.

Surface Active Agents.....Technical Bulletin on Surfynols—a new class of nonionic surface active agents. Suggested uses: low foam detergent formulations—anti-gelling agents—viscosity depressants—etc.
407F Air Reduction Chem. Co.

Urea.....Wide variety of uses makes it one of the world's most basic and versatile chemicals. Folder covers details on Grace crystal urea for industry — description, solubility in water, applications, etc.
407G Grace Chem. Co.

Zinc Dust.....Zinc dust as a reducing agent offers valuable advantages: original cost lower than most commonly used agents; works in alkaline & acidic solutions of varying pH; etc. Furnishes half-pint sample.
407H Federated Metals Div.

Process Equipment

Autoclave-Reactors.....Company provides engineering knowledge, fabricating skill, facilities...for greater reliability. In any capacity, for any pressure, temperature or reaction. Full details in Catalog 2413.
93 Blaw-Knox Co.

Blenders.....Twin shell blenders feature more thorough blending in a fraction of the time previously taken. One blender replaces methods which required a separate drum for every mix. Full details in Catalog 12.
105 Patterson-Kelley Co.

Cleaners, Air, Oil Bath.....Announces a new low resistance type Cycoil oil bath air cleaner for engines using turbo-chargers or pressure blowers for scavenging. Offers complete information in Bulletin 160-A.
407I American Air Filter Co.

Cleaners, Blast.....New, low-cost blast cleaner features completely dust-free cleaning in a wide range of applications. Includes information on numerous uses, operating advantages, special design features, etc.
407J Vacu-Blast Co.

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In Australia: Swift & Company, Pty., Ltd., Sydney
In Japan: F. Kanematsu & Co., Ltd., Tokyo

Cleaning Accessories, Blast.....Informative and illustrated Bulletin fully describes accessories and supplies for blast cleaning. Covers nozzles, helmets, hose, gloves, sleeves, aprons, leggings, etc. No. 300C.
408A Pangborn Corp.

Cleaning, Blast, Airless.....20 p. Bulletin describes the RF Rotoblast, shows its applications in various types of equipment, lists typical products cleaned & various finishes that can be secured. No. 214.
408B Pangborn Corp.

Columns, Fractionating.....Offer unusual advantages in solving fractionating & absorption problems. No corrosion, no contamination. In 4" & 6" sizes with any number of plates. Full details covered in Data Sheet.
167e Corning Glass Wks.

Crushers, Mud Hog.....Traveling breaker plate non-plug crushers for reducing all types of wet, sticky materials. Covers general specifications, sizes, capacities, horsepower and weights, in illustrated Bulletin 864.
408C Jeffrey Mfg. Co.

Demineralizers.....Valuable data on advantages & types of demineralizers, applications of demineralizing, principles of demineralization, ion exchange resins, etc., in completely illustrated Bulletin WC-111.
408D Graver Water Conditioning.

Discs, Rupture.....For low pressure and highly corrosive applications. Offers complete details on construction, operation, pressure ranges, manufacturing tolerance, choice of materials, etc. Catalog 77-30.
408E Black, Sivalls & Bryson.

Dryers.....Work continuously, automatically, economically, extracting vaporous moistures from instrument air...reducing dewpoint in air lines to as low as —100°F. Covers their operation and usage.
171 Pittsburgh Lectrodryer Corp.

Drying, Vacuum.....Company offers informative brochure, "Vacuum Drying," which contains valuable data on techniques of moisture removal from chemicals, pharmaceuticals and other industrial products.
289 F. J. Stokes Mach. Co.

Dust Collectors.....Incorporate tried-&-proven principles of reverse-air-jet dust filtering . . . & specifically designed to increase dust collector efficiency particularly in handling heavy dust loads. Illustrated.
408F Turner & Hawa Engrg. Co.

Dust Control.....Describes most direct method for determining the scope of your dust problem & your dust control equipment needs in new manual, "A Simplified Test Method for Dust Control Determination."
R353 Dustex Corp.

Dust Control.....A Dustube installation features dust control that is more efficient, less costly, and better engineered to your specific requirements. Offers complete data on these advantages in Catalog 372.
285 American Wheelabrator.

Dust Control.....Includes technical discussions & drawings of a variety of cupola dust control systems—among them being washing, dry suction cyclone, combination gas conditioner & suction bag. Bulletin No. 3.
408G Mechanical Industries.

Dust Control.....Manufacturer of blast cleaning and dust control equipment issues a 24 p. illustrated Bulletin covering entire company line of equipment and accessories. Features simplified index. No. 1210.
408H Pangborn Corp.

Dust Control.....Pioneers and leaders in industrial dust control for all process operations—crushing, screening, milling, grinding, blending, mixing, drying, etc. Full data on flat bag dust filters in Bulletin 98.
411 W. W. Sly Mfg. Co.

Dust Recovery.....New profits in terms of valuable dust that can be returned to production rather than wasted in the air. Makes available an informative Brochure which describes 3 systems of industrial dust recovery.
271a Buell Engrg. Co.

Evaporators, Turba-Film.....Evaporators give rapid one-pass evaporation of liquids, slurries and gases . . . especially heat-sensitive substances . . . all by continuous process. Brochure containes complete information.
43 Rodney Hunt Mach. Co.

Filters, Pressure Leaf.....For flow rates two to five times greater than cloth covered presses; positive removal of all suspended solids to desired degree of clarity; etc. Details in illustrated Catalog NC-1-53.
209 Niagara Filters Div.

Filters, Vacuum.....Designed for modern sludge dewatering requirements. Provide valuable features: non-clogging; permanent filter media; constant output; low operating cost. Details in illustrated Bulletin 102.
408I Komline-Sanderson Engrg. Corp.

Flakers.....Produce granular or flaked material from caustic soda, asphalt, DDT, benzine, etc. Offer continuous operation . . . large capacity . . . product free of lumps. Full information in illustrated Catalog No. 352.
89 Blaw-Knox Co.

Gas-Liquid Contact Equipment.....Save on space, time, money with gas-liquid contact equipment. Intimate contact between gas and liquid results in high mass transfer rates— efficient scrubbing action. Bulletin 203B.
403 Peabody Engrg. Corp.

Generators, Inert Gas.....Generators help meet purging or blanketing problems. Complete with the latest fire checks and safety devices. Company makes available full details and technical information in Bulletin 1-10.
54 C. M. Kemp Mfg. Co.

Granulators.....In a range of four sizes . . . provide many unique features. Include all steel construction, double supported, ruggedly mounted, hardened rotor, absolutely no flyback of materials, etc. Illustrated.
408J Alsteele Engrg. Wks.

Homogenizers.....Four ways homogenizers made better emulsions & dispersions: make them uniformly finer; disperse them evenly; prevent separation; save processing time & money. Bulletin provides full information.
285a Manton-Gaulin Mfg. Co.

Kettles.....Corrosion-resistant kettles meet every processing need. They are practical, easy to clean and keep clean, meet all sanitary regulations and are available in sizes up to 500 gallon capacity. Offers Bulletins.
BR354 Lee Metal Products Co.

Kilns, Rotary.....Every part is precision designed, precision built to give you maximum protection against mechanical troubles of all kinds. Covers application data in illustrated 28 p. Bulletin A-442.
160 Vulcan Iron Wks.

Mills.....Help solve grinding, crushing & separating problems. Company line of "proved-in-service" machines offers a better product...faster production ...& lower costs. Details in descriptive literature.
56a Williams Patent Crusher.

Mixers.....Homo-Mixer is built & operates on an entirely new principle. Draws only from the bottom of the tank with no vortex. Contains complete information on features & performance in Catalog 402.
TL352 Admiral Tool & Die Co.

Mixers.....Jet mixers feature faster, more thorough mixing. Offers fully illustrated Bulletin covering data on the theory of operation, interchangeable rotors, production capacities, applications, etc.
408K Hermans Mach. Co.

Mixers.....Agitation specialists show how their services can help you attain the desired goal in process agitation—highest efficiency at lowest outlay cost. Covers mixer line in illustrated Catalog B-105.
207g Mixing Equipment Co.

Mixers.....Company makes available Confidential Mixing Data Sheet. Helpful checklist enables you to develop a complete technical description of agitation required for your process, quickly & easily. No. B-107.
207h Mixing Equipment Co.

Mixers.....Fully illustrated & detailed Bulletin features valuable information on the company line of open & closed tanks, top-entering mixers, side-entering agitators, filters, transfer pumps, etc. No. C-652.
408L Alsop Engrg. Co.

Mixers, Laboratory.....Laboratory mixers: electric motor driven, direct drive, variable speed and geared models. Air motor driven models also available. Offers complete details in Bulletin DH-50.
207a Mixing Equipment Co.

Mixers, Portable.....Use in industry reduces costs, saves time, labor and secures better and more refined products. Catalog includes data on construction, dimensions, specifications, etc. 28 p. No. B-108.
207b Mixing Equipment Co.

Mixers, Proportional.....Automatically mix gaseous fuels with air or oxygen in proper ratio at all times regardless of whether burners are on high or low fire. Full details in 4 p. illustrated Bulletin L.
408M Eclipse Fuel Engrg. Co.

Mixers, Side Entering.....Furnishes detailed information on features, typical applications, mechanical design, maintenance, shaft seals, methods of installation, etc. in completely illustrated Catalog B-104.
207c Mixing Equipment Co.

Mixers, Top Entering.....Makes available pertinent information on top-entering mixers (propeller type)... for closed tanks, pressure and vacuum ...for open and loose-covered tanks. Catalog B-103.
207d Mixing Equipment Co.

Mixers, Top Entering.....Illustrated and detailed 32 p. Catalog includes advanvantages, typical installations, mechanical description, construction information, dimensions and selection tables, etc. No. B-102.
207e Mixing Equipment Co.

Presses, Continuous.....Company line of continuous presses are provided in three sizes...and are the most efficient method of extracting excess moisture from semi-solids...at lowest possible cost. Full data.
TL364a Davenport Mach. & Foundry.

Presses, Filter.....Data on numerous features: low first cost; low operating cost; long service life...high resale value; operate to 1000 psi at high or low temperatures; etc. Offers full details in Catalog 52.
413 T. Shriver & Co.

Presses, Filter.....Feature valuable advantages—flexibility...superior performance...economy. Includes data on types, operation, materials of construction, applications, accessories, installations, etc. 44 p.
408N D. R. Sperry & Co.

Process Equipment.....Custom engineered equipment for petroleum refineries...chemical & power plants. Included are stills & towers, heat exchangers, reactors, oil chillers, etc. Illustrated Bulletin E-1.
408O Henry Vogt Mach. Co.

Processing Equipment, Liquid.....Offers a complete line of filters, mixers, tanks, and pumps designed and manufactured to exacting standards and of the finest materials. Details in 22 p. illustrated Bulletin G-553.
408P Alsop Engrg. Corp.

Propellers.....Data on smooth, vibrationless propellers for stirring, mixing, aerating, pumping, etc. Balanced to avoid whip and strain on shafts. Available in a wide variety of metals, and in sizes up to 60 inches.
BL352 Michigan Wheel Co.

Reformers.....Offer dependable, flexible cost-reducing solution for the problem of producing a gas that is interchangeable with manufactured or natural gas. Complete details in illustrated Bulletin E-30.
409A Koppers Co.

Separator - Concentrator.....Parallel Drive DH-2 Nozljector offers both... efficient use of power input up to 50 horsepower...plus over 50% greater capacity in the same size centrifuge. Details in Bulletin 1276.
131 Sharples Corp.

Separators, Centrifugal.....Extremely efficient operation assures finer separation of fine material from coarse material. Increased output with lower power cost. In sizes 3 to 16 feet in diameter. Bulletin 087.
288a Sturtevant Mill Co.

Shot Peening.....Shows possibilities of shot peening for the manufacture of flexing parts under stress. Covers factors responsible for successful shot peening & methods of assuring these factors. Bulletin 2144.
409B Pangborn Corp.

Vessels, Processing.....Illustrates and describes the different operations and conditions for which these vessels are made, and describes the 4 different ways in which company operates, in fully detailed Folder.
409C Bethlehem Foundry & Mach.

Wheels, Grinding.....New 28 p. Catalog describes reinforced resinoid line of grinding wheels. Included are typical application photos, tables of wheel sizes, prices, operating speeds & other data. No. 1748.
409D Norton Co.

Pumps, Blowers, Compressors

Blowers.....Precision manufactured to move more gas or air with less wear than other blowers of equal size or weight...and with less maintenance and power costs. Bulletin describes Standardaire Blower line.
823 Read Standard Corp.

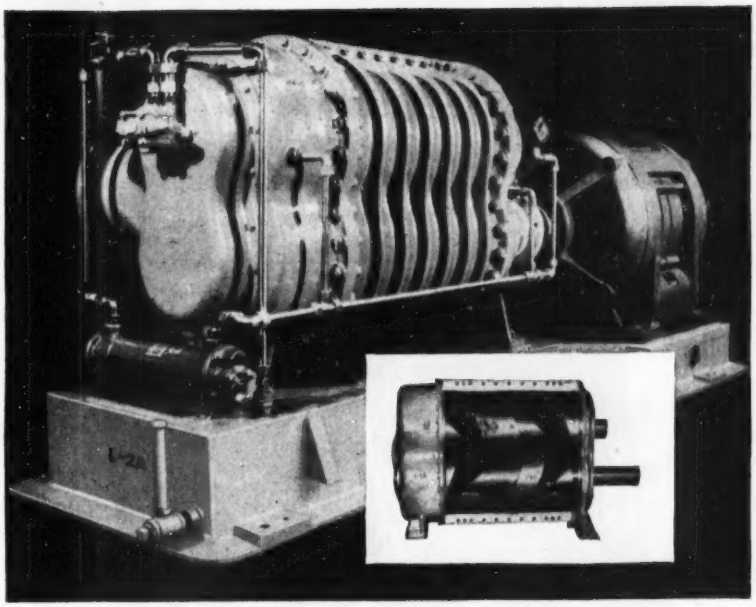
Compressors.....Literature on latest developments in mechanical scavenging of 2-cycle engines by rotary blower. Performance charts diagram resulting increases in engine power and fuel savings. 22p. Bulletin 75.
409E Cooper-Bessemer Corp.

Compressors, Centrifugal.....Makes available a complete line of centrifugals for gas compression and refrigeration—up to 10,000 horsepower in a single unit. Data in booklet, "Centrifugal Compressors for Industry."
57 Carrier Corp.

Compressors & Pumps.....Illustrated Bulletin covers operation & construction of single-stage water-cooled rotary compressors & vacuum pumps applicable to every air or gas handling requirement. 12 p. No. 16B8126.
409F Allis-Chalmers Mfg. Co.

Fans.....Feature forwardly-curved blading specifically designed for induced draft application in steam plants of public utilities & industrial plants for both process steam & power generation. 8 p. Catalog 1380.
409G Westinghouse Sturtevant Div.

Pumps.....Announces the publication of an illustrated catalog sheet which describes the operation and advantages of the Hypro G3800 gasoline engine powered pump. Includes data on uses and specifications.
409H Hypro Engrg.



Wide range of pressures and capacities add new opportunities for economy with R-C SPIRAXIAL COMPRESSORS

The 10 sizes now available in the new Roots-Connersville SPIRAXIAL COMPRESSORS provide a capacity range from 700 cfm to 5,000 cfm, with pressures from 15 psi to 30 psi, in single-stage units. Where greater air volumes are required, multi-stage installations are completely practical. The result is that the amazing efficiency and economy of this latest R-C development can be utilized in many applications not fitted to the earlier SPIRAXIAL machines.

Already, users of R-C SPIRAXIALS are profiting from these outstanding advantages:

1. **No internal lubrication—hence oil-free air**
2. **Peak efficiencies at required pressures**
3. **Direct-connected for speeds of 1750 rpm and 3550 rpm**
4. **Uncooled—requiring no water-jacketing**
5. **Small space . . . low noise level**

If you are planning new installations, we suggest a study of the possible economies of R-C SPIRAXIALS. Or, it may well be that SPIRAXIALS will pay for themselves as replacements for present less efficient equipment.

Ask for details in Bulletin SC-253, or for an analysis of your needs by R-C engineers.

1854 1954

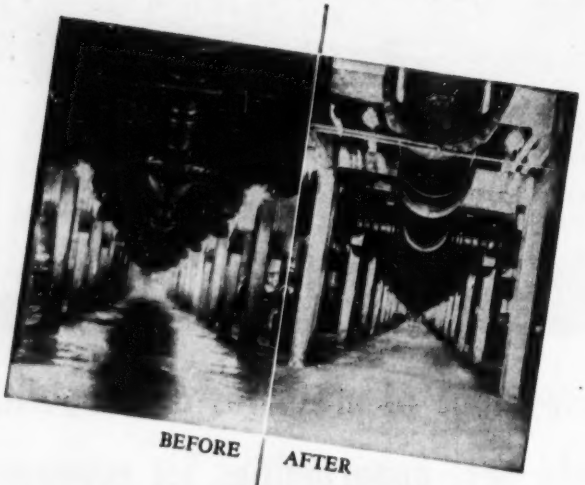
ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
854 Illinois Ave. • Connersville, Indiana

ROOTS R C SINCE 1854 CONNERSVILLE

how

pipe galleries stay dry



surrounded by cold water

The pipe galleries in Chicago's water filtration plant are surrounded by Lake Michigan water, as cold as 40° F. Before Kathabar, condensation literally created a fog in the galleries, corroded expensive equipment, rotted wiring, peeled off paint.

Moisture removal by refrigeration was impractical under the conditions prevailing. Kathabar dehumidifying units completely dried up the galleries by lowering the dewpoint of the air. Eliminating the condensation damage the Kathabar units pay for themselves in less than 3 years.

This is one of the many contributions of Kathabar humidity engineering. It is used for the packaging, processing, storage, and testing of many products. By preventing frost, condensation, corrosion, and supplying direct dehumidification, Kathabar saves money and improves product quality .

Wherever atmospheric moisture is a problem, Kathabar engineers will be glad to help you find a cost-saving solution.

Write for literature
Group K-53-4.

Kathabar
HUMIDITY CONDITIONING

SURFACE COMBUSTION CORP., TOLEDO 1, OHIO

ALSO MAKERS OF

Surface INDUSTRIAL FURNACES *Janitrol* AUTOMATIC SPACE HEATING

LITERATURE . . .

Pumps.....Full hydraulic balance... Dual-Vane construction provides and assures increased efficiency at higher pressures while reducing wear to the absolute minimum. Details in illustrated Bulletin DP-302.
410A New York Air Brake Co.

Pumps.....Provides information on corrosion-resisting pumps for heavy-duty chemical service. Available in 12 standard alloys to supply heads to 240 ft. and capacities to 2000 gpm. Complete details in Catalog 54.
235 Duriron Co.

Pumps, Centrifugal.....Hydrodynamically sealed pumps without stuffing box—for handling abrasive and corrosive liquids...liquids which must not be mixed with sealing water...etc. Illustrated Catalogue Z 3011 B.
278A Jonkopings Mekaniska Verkstad.

Pumps, Centrifugal.....Corrosion-resistant products for fluid handling include a complete line of buna "N" and natural hard rubber centrifugal pumps, valves, pipe, and fittings. Full details in Bulletin BHR.
410C Vanton Pump & Equipment.

Pumps, Centrifugal.....End suction centrifugal pumps feature superior performance...from a tough liquid handling problem to pumping plain water. Full details, illustration of construction, etc., in Bulletin 4011.
324 Deming Co.

Pumps, Centrifugal.....Erosion and corrosion resistance of high strength, fully glazed porcelain is combined with ruggedness of heavy cast iron armor. Includes valuable engineering data, diagrams, photographs, etc.
410D General Ceramics Corp.

Pumps, Centrifugal.....Issues a new Bulletin on saddle mounted, vertically split centrifugal pumps...designed for continuous duty in all boiler circulation & heater drain services. Illustrated. No. W-341-B11B.
410E Worthington Corp.

Pumps, Centrifugal.....Offer continuous, trouble-free operation. No leakage or contamination of fluids...completely contain expensive, toxic, or corrosive fluids...protect plant and personnel. Data in Bulletin G-1000.
71 Chempump Corp.

Pumps, Centrifugal Vertical.....Designed to handle molten sulphur. Steam jacketed discharge pipe keeps molten materials from solidifying. Work efficiently at the relatively slow speed of 1750 rpm. Bulletin V-837.
TL343 Taber Pump Co.

Pumps, Diaphragm.....New & modern engineering approach to diaphragm pump design. Wheelbarrow type mounting enabling one man to handle on the job. Handles fold alongside when not in use. Illustrated.
410F Rice Pump & Mach. Co.

Pumps, Dredge.....Offer most-wanted features in a dredge pump. Include lowest cost per ton moved, durability, reliability, simplicity, minimum hp, easy maintenance, good vacuum performance, etc. Bulletin 184.
410G Morris Mach. Wks.

Pumps, Plastic.....Pumps becoming industry's standard for difficult to handle corrosive solutions and abrasive slurries. Unique design eliminates stuffing boxes, shaft seals, gaskets, and check valves. Bulletin VP.
410H Vanton Pump & Equipment.

Pumps, Process.....Available in a wide choice of materials—to handle many types of abrasive or corrosive material at temperatures to 250° F. Individually engineered to each application. Bulletin 52B6615.
303 Allis-Chalmers Mfg. Co.

Pumps, Rotary.....Feature high suction & rugged construction to unload or transfer high melting point, or low penetration asphalts at cooler temperatures than other rotary pumps. Covers full line in Bulletin L51.
395 Kinney Mfg. Div.

Instruments & Controls

Actuators, Valve.....Covers tandem type actuators for valves requiring relatively high torques to operate, and new floating bar type actuators for use on valves requiring lower operating torques. Bulletin 3020.
411A Ledeen Mfg. Co.

Analyzers.....For the process plant. For continuous control of liquid or gas streams. Record ratio of any 2 wavelengths chosen. Thermostatted; enclosed in explosion-proof containers. Fully illustrated.
302a Perkin-Elmer Corp.

Analyzers, Gas.....Electro-conductivity gas analyzers by Davis with instrumentation by Honeywell described & illustrated. Includes pertinent data on theory, operation, applications, in Data Sheet No. 10.15-12.
411B Minneapolis-Honeywell.

Analyzers, Gas.....Infrared gas analyzers designed for plant analyses of gas compounds in multi-component streams. Feature no moving parts—no lenses—no mirrors. Information in Demonstrator ND46-91(1).
64 Leeds & Northrup Co.

Analyzers, Multi-Component.....For the pilot plant. Continuously record the concentration of up to six components in a pilot process stream on a six-minute cycle. Bulletin furnishes complete information.
302b Perkin-Elmer Corp.

Cabinets, Test.....Hudson Bay environmental test cabinets for Jan & MIL tests, product evaluation & research activities shown in new Instrumentation Data Sheet. Covers all aspects of versatile line. No. 11.0-8.
411C Minneapolis-Honeywell.

Comparators.....Announces a new portable comparator for calibrating extensometers, compressometers, dial gages, etc. Feature small size & elimination of mechanical linkages as a source of error. Bulletin 4210.
411D Baldwin-Lima-Hamilton Corp.

Control Equipment, Steam & Liquid..... Illustrated, 56 p. covers pertinent data on pressure regulators, temperature regulators, combination pressure and temperature regulators, float valves, etc. Catalog 54.
411E O. C. Keckley Co.

Control Systems.....Cabinetrol panels form a standard low-voltage control system that handles all motor types up to 600 hp from central location. Offers complete information in descriptive Bulletin GEA-3856.
156 General Elec. Co.

Controllers, Ratio.....Controllers regulate critical gas mixtures in carbon black production. Makes available detailed reference data—Catalog 2320, "Flow Meters, Indicating, Recording, Integrating and Controlling."
16-7 Minneapolis-Honeywell

Controllers, Recording.....Offer reduced maintenance through the "Magnetic Standard" in potentiometers and an improved bridge balancing unit in a-c bridge instruments. Covers full data in Bulletin GED-2100.
173 General Elec. Co.

Controls, Automatic Scales.....New Technical Reference covers controls for automatic scales. Describes sequence of operations involved in weighing, indicating and recording processes. Fully illustrated. No. 53J.
411F Richardson Scale Co.

Controls, Temperature.....Company line of controls offer dependable, cost-saving regulation of temperature or pressure...help improve operations. Makes available descriptive information on controls. Catalog PC-D.
314 Fulton Sylphon Div.

SLY PIONEERS and LEADERS in INDUSTRIAL DUST CONTROL

for all process operations

CRUSHING
MILLING
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BLENDING
MIXING
DRYING
SEPARATION
FEEDING
CONVEYING
ELEVATING
WEIGHING
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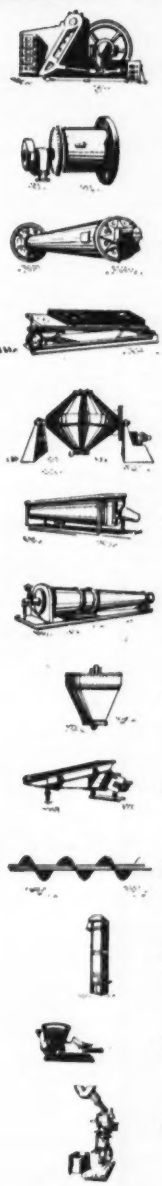
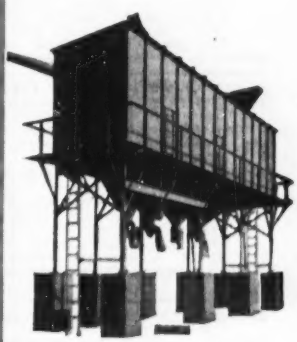


SLY FLAT BAG DUST FILTERS



GET ALL OF THE DUST FROM THESE OPERATIONS

SEND FOR BULLETIN 98

THE W. W. SLY MANUFACTURING CO.
4771 TRAIN AVENUE • CLEVELAND 2, OHIO
New York • Chicago • Philadelphia • Syracuse • Detroit • Buffalo
Cincinnati • St. Louis • Minneapolis • Birmingham • Los Angeles • Toronto

Controls, Thermal.....Help solve temperature control problems which involve heat, humidity, radiant heat, pressure and other variables. Brochure offers complete explanation of unique Thermoswitich units.
82 Fenwal, Inc.

Controls, Valve.....LimiTorque is the latest and most advanced valve control for operation of small valves. Includes description, application, features, ordering data, etc., in illustrated Bulletin SMA-000.
412A Phila. Gear Wks.

Detectors, Metal, Electronic.....Help to solve tramp metal problems. Sensitive to all metals...detect even minute particles & signal their presence... thus protecting processing equipment. Offers data in Bulletin B-1920-A.
397 Dings Electronics.

Gages.....For pressure, vacuum or compound service. There are no gears or teeth to wear out. Cam wiping action keeps contact points clean and smooth. Provides complete information in Catalog No. G-2.
332 Helicoid Gage Div.

Gages.....Non-frosting gages provides the highest possible accuracy of reading on low temperature, low boiling point liquids...insure less turbulence at the meniscus, and clear vision at the vision slot. Complete data.
L354 Jerguson Gage & Valve Co.

Gages, Liquid Level.....Presents valuable data on liquid level gages: reflex; thru vision; tubular. Standard equipment in leading refineries and industrial plants all over the world. Complete Catalog and specifications.
BL357 Strahman Valves.

Gages, Liquid Level.....Supplies a fully illustrated Catalog covering practically the complete company line of liquid level gages and valves with a condensed presentation of pertinent information. No. 236.
412B Jerguson Gage & Valve Co.

Gages, Tank.....Company makes available pertinent information on their line of 100% automatic Liquidometer tank gages for gaging liquids of all kinds. Gages are approved by the Underwriters' Laboratories.
TR354 Liquidometer Corp.

Indicator-Recorders.....Covers compact, low-friction mechanical instruments for checking and recording the rate of feed of volumetric feeders by the loss-in-weight principle. Details in illustrated Bulletin 50-L13.
412C Omega Mach. Co.

Indicators, Dew Point.....Read dew points instantly . . . accurately. Dewpointer is completely self-contained, requires no external coolant or auxiliary apparatus. Operates on either a.c. or enclosed battery. Illustrated.
R364 Illinois Testing Labs.

Indicators, Temperature.....Describes 2 portable temperature indicators—Potentiometer Indicator & Resistance Thermometer—for heavy duty use. Includes operating adjustments, design features, etc. Bulletin A-303.
412D Foxboro Co.

Instruments, Mechanical.....Covers full line of mechanical industrial instruments—fixed stem and distant reading dial thermometers, temperature and pressure recorders, etc.—in illustrated Catalog M-2-A.
412E Weston Elecl. Instrument Corp.

Logger Systems, Multi-Point.....Designed around Brown ElectroniK strip chart recorder—measure & record temperatures or other variables from 144 different points in test cell, plant process, etc. Bulletin 1570.
412F Minneapolis-Honeywell.

Meters.....Describes Conveyoflo meters —for continuous, accurate weighing of bulk materials passing over conveyor belts. Respond accurately to rapid load variations. Complete details on features in Bulletin 550-H4.
241 Builders-Providence.

Meters, Flow.....New design incorporates a rugged simplicity...& is virtually trouble-free, requiring little or no maintenance. Includes features, operation, specifications, etc., in illustrated Catalog 1027.
412G Penn Industrial Instrument.

Meters, Flow.....Feature simple design with only three moving parts—no breakdown due to complicated gears and mechanism. Indicate flow within 3% absolute accuracy, even with pulsating flow. Complete data.
BR362 Henszey Co.

Meters, Flow.....Compact, single or multi-tube flow indicators specifically designed to provide full Rotameter accuracy in measuring non-corrosive liquids and gases at moderate pressures. Data in Bulletin 190.
412H Brooks Rotameter Co.

Meters, Flow.....Provides valuable data on accurate, single stage, variable area industrial flow meters. Built for low cost flow rate measurement in a wide range of production processes. Bulletin No. 1048.
412I Commercial Research Labs.

Panels, Control.....Covers control panels for use with weighing and materials handling systems, motor controls, machine tools and plant processes. Included are pictures of 27 typical panels. Bulletin No. 6254.
412J Richardson Scale Co.

Proportioning Systems, Carbon Black.....Illustrates a remote-controlled system for proportioning carbon blacks in rubber compounding operations. Covers proportioning cycle. Technical Reference 53A.
412K Richardson Scale Co.

Recorders.....New miniature electrical recorders offer extreme compactness ....Cormag self-shielding mechanism ...A-C and D-C models. Bulletin available covering complete specifications and prices.
87a Weston Elecl. Instrument.

Regulators.....Describes & illustrates newly developed electronic regulator for speed, voltage, & current (tension) regulation for industrial electric motor drives. Offers complete data. Bulletin K-2076.
412L Reliance Elec. & Engrg.

Regulators, Pipeline.....New series designed for use with gases supplied by pipeline systems using comparatively low pressures. Offer long life, trouble-free operation, ease of repair, etc. Catalog ADC 705.
412M Air Reduction Sales Co.

Spectrometers, Mass.....New company line of analytical mass spectrometers offers greater speed, accuracy and versatility. Pertinent information on features and operation contained in Bulletin No. CEC 1800C-X1.
213 Consolidated Engrg. Corp.

Tachometers, Hand.....Covers new double range hand tachometers with stop button feature to hold readings until released. Compact, rugged, simple to use, easy to read, etc. Data in illustrated Bulletin 765.
412N Herman H. Sticht Co.

Testing, Environmental.....New Folder, "Environmental Testing for Proof of Design," describes such tests as vibration, shock, acceleration, high & low temperature & temperature shock, etc. Illustrated.
4120 New York Testing Labs.

Transmitters, Pneumatic.....Presents the full story about Republic transmitter flexibility. Describes complete line of transmitters, including the square root extracting & pneumatic electric models. Data Book.
298 Republic Flow Meters Co.

Transmitters, Pneumatic.....Operating details & specifications of new force balance Rotameter float position transmitter for use with all types of pneumatic receivers &/or control instruments. Bulletin No. 170.
412P Brooks Rotameter Co.

Watches, Stop, Electric.....Recommended for radioactivity counting systems in atomic laboratories, in addition to conventional use as accurate, split-second timers in other research work. Data in Bulletin 646.
412Q Precision Scientific Co.

Weighing Systems.....For measuring load, fluid pressure, or torque more accurately and economically. Makes available complete details in Booklet 4106 on tank weighing and Booklet 4105 on crane scales.
98 Baldwin-Lima-Hamilton Corp.

Construction Materials

Adhesives, Lagging.....20 p. Reference Manual covers data on lagging adhesives, sealers, surface coatings, fire retardant mastics and vapor barriers. Includes full technical product information. No. 545.
412R Benjamin Foster Co.

Alloys, Cast.....Technical Booklet covers major stainless alloys. Includes chemical composition, mechanical & physical properties, resistance to major corrosive solutions, machinability, heat treatment, etc.
412S Cooper Alloy Foundry Co.

Castings, Alloy.....Presents 48 p. Bulletin for users and potential users of stainless and heat-resistant alloys in cast form. Complete details on industrial applications. Charts, photos, tables, etc. No. A-141.
412T International Nickel Co.

Coating Systems, Protective.....The modern approach to maintenance-painting halts corrosion. Sixteen specialized protective coating systems cover requirements of hundreds of strong corrosives. Bulletin No. MC-8.
301b United Chromium.

Coatings, Protective.....Ceramic coatings and porcelain enamels—for all industrial applications—combat corrosion...resist abrasion...withstand high temperatures...offer special dielectric properties. 6 p.
412U General Ceramics Corp.

Coatings, Protective.....Issues a new, 16 p. fully illustrated booklet on the subject of positive protection...a system of custom-made protective coatings for the chemical process and allied industries.
412V Rowe Paint & Varnish Co.

Coatings, Protective.....Detailed Bulletin covers five types of vinyls, with complete primer requirements for all types of surfaces, including rusty steel and old coatings. Pertinent data on use. No. 200.
412W Carboline Co. Div.

Coatings, Protective.....For any equipment or surface that can be uniformly baked...Plastisol compounds offer easy, economical way to apply long-lasting vinyl coating protection. Details in Bulletin No. VP-1.
301c United Chromium

Coatings, Protective.....Reinforced asphaltic coatings provide many uses—rust prevention, vaporsealing thermal insulation, waterproofing building walls, dampening sound & vibration, etc. Booklet No. GM-100.
412X Insul-Mastic Corp. of America.

Coatings, Protective.....Catalog designed to simplify problem of selecting the correct protective coating for various industrial installations. Covers properties, applications, etc. for each coating. Bulletin C-150.
344 Celicote Co.

Coatings, Protective.....Covers Dip-Pak hot-melt plastic coatings. Lists the types, including base plastics, colors, physical properties, corrosion resistance, melting and application temperatures for each. 4 p.
412Y Fidelity Chem. Products Corp.

Coatings, Protective.....Makes available a detailed Folder listing metal-protective and paint-bonding chemicals for steel, zinc, aluminum, and other metals with industrial applications. Advantages and process data.
413A American Chem. Paint Co.

Coatings, Protective.....Flexible, unplasticized, single package, pigmented, fast drying furan base resin coating. Resistance to acids, alkalies, solvents to temperatures as high as 190°F. Bulletin 400.
413B Carboline Co.

Coatings, Resin Base.....For the chemical industry. Specific applications include tank cars, oil pipe, acid tanks, shipping containers, etc. Tabulates effects of chemicals on vinyl resin-base coatings. 8 p.
65 Bakelite Co.

Electrodes, Welding.....Illustrated, 24 p. Bulletin on stainless steel welding electrodes. Covers metallurgy of stainless steels provides A. O. Smith stainless steel electrode selector table, etc. No. WE-166.
413C A. O. Smith Corp.

Fabrication, Metal.....Presents detailed booklet, "Facilities and Products," containing data and photographs which show why the company can turn out—at low cost—specialized heavy equipment for chemical plants.
74 Newport News Shipbuilding.

Fabrication, Metal.....Complete fabricating & assembling facilities for any type, size & quantity of sheet & plate products & weldments thru 8" thickness. Offers details in "Sheet & Plate Fabrication."
326 Kirk & Blum Mfg. Co.

Fabrication, Metal.....Manufacturers metal products for numerous industrial uses...from complete carbon-black plants to steel conveyor boxes. Designs, engineers and fabricates to specific needs. Full details.
350 Boardman Co.

Fabrication, Weldment.....Photos of unusual applications of welded fabrication featured in new Brochure. Among the weldments shown are complex rotors, housings, bases, machinery frame members, shells, etc.
413D Acme Welding.

Film, Polyester.....Features an unusual combination of physical, electrical, chemical, & thermal properties. Offers complete details in 20 p. illustrated, "New Developments in 'Mylar' Polyester Film."
413E E. I. du Pont de Nemours.

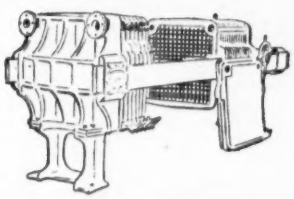
Flooring, Concrete.....Designed to resist heavy impact & abrasive action of rolling & skidded vehicles . . . new iron-chip seeding process bonds a non-spalling, non-slip armor to rugged Dynapakt concrete topping.
413F Flash-Stone Co.

Lead Products.....For the efficient control of corrosives. Provides all common mill shapes, sizes and forms . . . sheet, pipe, fittings, valves, etc. Makes available new detailed booklet, "Chemical Lead Products."
127 National Lead Co.

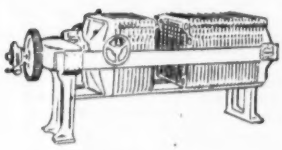
Linings, Drum.....Unichrome drum linings deliver resilient, seam-free, pore-free protection against such materials as acids, alkalies, salt solutions, alcohols, detergents, etc. Descriptive Bulletin No. DL-2.
301a United Chromium.

Masonry, Corrosion-Resistant.....'How to Build an Acid-Proof Brick Floor" & "Corrosion-Resistant Masonry Construction Guide" offered for those concerned with any type of corrosion-resistant masonry.
102 U. S. Stoneware Co.

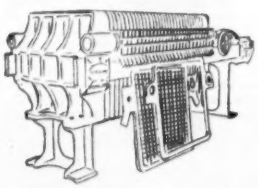
Panels, Wall, Insulated Metal.....Supplies description, technical data, specifications & construction details. Valuable features: superior thermal qualities economical permanent; flexible; etc. 8 p.
413G Steelcraft Mfg. Co.



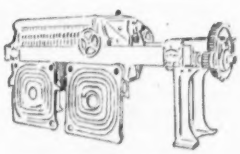
Filter to Recover Solids



Clarify • Purify



Wash • Extract • Redissolve



Thicken • Leach

Filter without Leakage or Evaporation

Low First Cost — The Shriver Filter Press provides filtering capacity at low cost per square foot of filtering area.

Low Operating Cost — Easy to assemble and operate with unskilled labor. No complicated moving parts. Requires minimum floor space and head room.

Permanent High Value — Because of versatility, long service life, low depreciation and high resale value.

Portable — Smaller units can be made entirely portable, with press, pump and piping mounted on an easily movable base; larger units are easily taken apart and reassembled.

Use All Filter Media — Can use any cotton, synthetic fibre, asbestos, glass, wire mesh or other types of cloth or filter paper and any filter aids.

For Any Temperature • Pressure • Capacity — Can operate at any pressure to 1000 p.s.i. and at high or low temperatures. Any size to 10,000 G.P.H. and higher.

Corrosion Resistant — All parts of filter press which come in contact with material to be filtered can be made of any metal, wood, rubber, plastics, etc.

Write for Catalog No. 52

Filter Presses
Filter Media
Diaphragm Pumps

T. Shriver & Company, Inc.
802 Hamilton St. Harrison, N. J.

LITERATURE . . .

Platinum, Gold & Silver.....Company makes available two informative Folders—Folder No. C-20, "Platinum, Gold & Silver for Science, Industry & the Arts," & Folder No. C-21, "Platinum & Palladium Catalysts."
318 American Platinum Wks.

Process Equipment, Fabrication.....Designed and built around the use of Haveg—basic construction material that resists corrosion. Includes size and chemical resistance charts in 64 p. illustrated Bulletin F-6.
297 Haveg Corp.

Refractories.....By lasting longer, refractories automatically cut costly downtime losses . . . maintenance . . . and labor. Use of heat more efficiently results in increased production, reduced fuel costs. Fully detailed.
77 Carborundum Co.

Rubber, Silicone.....Super tough silicone rubber provides outstanding features: high tear strength; improved oil resistance; low compression set; excellent thermal stability. Bulletin contains full details. 4 p.
414A General Elec. Co.

Steels, Stainless.....44 p. General Catalog covers stainless steels, lists their applications, sizes and forms, and resistance to various corrosive media. Includes data on properties and fabricating operations.
76a Armco Steel Corp.

Steels, Stainless.....“Armco's ELC Stainless Steels” presents information on two extra-low carbon stainless steel grades that are completely satisfactory for service in welded equipment up to 800 F. Illustrated.
76b Armco Steel Corp.

Tantalum Equipment.....Immunity to hydrochloric, nitric & perchloric acids, iodine, bromine, etc. eliminates shutdowns, repairs, lost production time, spoilage, fume damage & other costly corrosion results.
333 Fansteel Metallurgical Corp.

Pipe, Fittings, Valves

Couplings, Hose.....Quick connect-disconnect hose coupling . . . for water, oil, steam, gas and chemical lines . . . provides permanent freedom from leakage. Covers complete data on construction. Illustrated, 16 p.
414B Titeflex, Inc.

Fittings.....Presents a Master Catalog which describes the complete range of products . . . compressed asbestos sheet packings for all purposes, valves, cocks, level gages, synthetic and silicone rubbers.
151a Klinger Corp. of America.

Fittings, Tube.....Supplies pertinent data on company line of tube fittings. Withstand several times the vibration of compression or flared tube fittings, and they are faster to install. Bulletin No. L-9335.
414C Samuel Moore & Co.

Joints, Ball.....Ball joints offer many features: no metal-to-metal contact between moving parts; chemically inert gaskets; stainless steel bodies; maximum flexibility; pressure safe; etc. Bulletin No. 215.
322 Barco Mfg. Co.

Nozzles, Spray.....Company makes available on request a completely detailed Catalog which provides valuable data on their Spraco Nozzle line. Includes information on the full cone, flat spray & hollow cone types.
TL357 Spray Engrg. Co.

Nozzles, WaterFog.....New light weight special aluminum-alloy WaterFog nozzles will extinguish or control fires in both ordinary combustibles and flammable liquids faster . . . and with less water. Illustrated.
414D Rockwood Sprinkler Co.

Pipe.....Illustrated Bulletin on special uses of vitrified clay pipe & Screw-Seal pipe in industrial duct installations. Unaffected by corrosive action of acids, gases & all commonly known industrial chemicals.
414E Robinson Clay Product Co.

Pipe, Ducts & Fittings.....Company announces a new corrosive resistant line of vent pipe, ducts, and fittings made of polyester bonded fiber glass. Furnishes a Bulletin outlining resistant properties.
414F Du Verre, Inc.

Pipe & Fittings.....Offers pertinent information on stainless steel welding fittings & welded pipe. Covers 90° elbows, 45° elbows, 180° returns, straight tees, stub ends, caps, etc. Specifications. Catalog No. 53.
414G Pypon Co.

Pipe & Fittings, Glass.....Glass pipe & fittings for full-scale production operations. Strengthened by end-tempering & feature corrosion-resistance, non-contamination, etc. Data in Catalogs EA-1 & EA-3.
167a Corning Glass Wks.

Pipe, Valves & Fittings.....Saran lined pipe, fittings & valves feature assurance of tight, leak-proof joints. Excellent corrosion-resistance of strong, rigid saran lined pipe means longer service, dependability.
328 Dow Chem. Co.

Piping, Stainless Steel.....Compiles information on numerous phases of piping application. Makes available upon request a valuable booklet on “the why and where” of stainless steel piping. Fully illustrated.
35-6b Tube Turns.

Tees.....Illustrated booklet, “Brawny,” introduces new company line of carbon steel welding tees. Covers all the advantages and furnishes list prices and complete dimensional and weight information. No. STF-2.
414H Northern Indiana Brass Co.

T-Heads.....Engineered and designed for use in fixed piping systems. It has a directional wide angle, medium velocity discharge and is installed in a pendent position. For automatic as well as open deluge use.
414I Rockwood Sprinkler Co.

Tubing, Stainless Steel.....Covers flexible stainless steel tubing developed to convey wide variety of searching & corrosive liquids & gases at high temperatures. Data on construction & types. Illustrated Bulletin STC-1.
55 American Brass Co.

Valves.....Describes the advantages of heat-holding design of Aloyco jacketed gate, globe, and check valves. Fact-filled Bulletin also includes information concerning specifications, uses, etc. No. 3.
223 Alloy Steel Products Co.

Valves.....Line of steel valves feature dependable operation and low maintenance cost. Gate, globe and check types handle the most severe high-pressure, high temperature services. Full details in Catalog 20.
300 Chapman Valve Mfg. Co.

Valves, Air Control.....Describes 3 fundamental types of air control valves. Covers primary advantages of air power including speed, cleanliness, economy, resiliency and lightness. Illustrated Bulletin No. 101B.
414J Ross Operating Valve Co.

Valves, Blast Gates.....Covers low cost, sturdy, manual control valves for air supply to gas or oil burners. Combination iron body & brass gate assures dependable operation . . . prevents “freezing.” Bulletin M-100.
414K Eclipse Fuel Engrg. Co.

Valves, Diaphragm.....Safer, easier to operate—reduce maintenance...for any service, any fluid within rated pressure and temperature. Provides full details on packless diaphragm valves in new, 24 p. Folder.
309 Crane Co.

Valves, Diaphragm Control.....Complete information on company line of diaphragm control valves in K&M Valve Engineering Data Catalog, Bulletin CV53. Also provides the new Valve Size Slide Rule Calculator.
40 Kieley & Mueller

Valves, Grooved End.....Comprehensive, completely illustrated Circular describes line of iron body bronze mounted grooved end valves for grooved end couplings. Includes features, dimensions & prices.
414L Lunkenheimer Co.

Valves, Solenoid.....For high pressure applications. Illustrates features of bronze or stainless steel pilot operated & direct lift solenoid valves with diagrams of electrical circuits. Details in Bulletin HP201.
414M Atkomatic Valve Co.

Valves, Solenoid.....Minimum of moving parts, simplicity of operation, assures trouble-free operation . . . high operating efficiency . . . maximum shutoff protection. Provides complete information in Bulletin M-500.
414N Eclipse Fuel Engrg. Co.

Valves, Thermostat.....New tank thermostat valves designed for dependable, low-cost temperature control on small storage tanks, kettles, bottle & can washers, industrial washing machines, driers, vulcanizers, etc.
414O Klipfel Valves.

Electrical Equipment

Circuit Breakers, Air.....Contains pertinent information, features, illustrations, etc. on various types of air circuit breakers. Includes data on weatherproof and dust-tight enclosures. Bulletin 5107-DR-1.
414P I-T-E Circuit Breaker Co.

Drives.....Illustrated 24 p. Bulletin describes new design of fractional hp Vari-Speed Motordrive. Sections on operating features & controls, installations, how to select, prices & ratings, etc. No. M-543.
414Q Reeves Pulley Co.

Drives, Control.....New, small, piston-operated control drives improve the flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders, and similar regulating devices. Data in Spec. CA040.
170a Bailey Meter Co.

Motor Starters.....New line designed for use where hazardous atmospheres and severe corrosive service conditions are encountered. Provides overall short circuit protection for 2200-5000 volt motors. Full details.
270O Electric Controller & Mfg. Co.

Motors.....For chemical service—built better to last longer. Combine maximum strength with tough, chemical-resistant insulation & corrosion-resistant frame & bearing brackets. Details in Bulletin B-2101.
165 Reliance Elec. & Engrg.

Motors.....Valuable new bulletin, “Motor Selector,” designed to help in quickly choosing squirrel cage induction motors, both new line and current line, for applications ranging from 1 to 200 horsepower. No. B-2102.
414S Reliance Elec. & Engrg. Co.

Motors, Totally-Enclosed.....For dirty or corrosive location or for outdoor operation in all kinds of weather. Available in ratings on frames larger than NEMA 505 up to 3000 horsepower. Data in Bulletin 51B7149.
215 Allis-Chalmers Mfg. Co.

Switches.....20 p. covers 22 “families” of switches, describing 258 different switches, actuators, enclosures. Dimensionalized photos, characteristics, electrical ratings, technical data, etc., in Catalog 101.
414T Micro Switch Div.

Switchgear.....24 p. guide to low voltage switchgear. Offers information on features, switchgear components, applications, specifications, construction. Illustrated with diagrams & photos. • Bulletin 6004A.
415A I-T-E Circuit Breaker Co.

Transformers.....Unit substation transformers, both liquid-filled & dry-type, designed to meet distribution requirements. In ratings thru 2000 kva, 15 kv & below. Information in Bulletins TU-13, TU-56.
290 Wagner Elec. Corp.

Mechanical Equipment

Chain, Metal.....Chain made of special heat-treated, alloyed ferrous metal. Features longer chain life . . . greater resistance to corrosion or abrasion . . . etc. Complete information in Bulletin 53-56.
415B Chain Belt Co.

Couplings.....Steelflex couplings offer unique multiple protection for connected machinery—overcome damaging conditions of shock loads, shaft misalignment and vibration. Engineering Bulletin covers details.
99 Falk Corp.

Gaskets, Spiral Wound.....Detailed Bulletin on spiral wound gaskets for pipe flanges; boiler manholes, handholes & tube caps; etc. Includes flange gasket & boiler gasket dimension tables. No. AG-953.
415C U. S. Gasket Co.

Gaskets, Teflon.....Engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Data in folder, "Teflon in Flexitallic Gaskets."
308 Flexitallic Gasket Co.

Packings, Valve & Pump.....V-rings, cup and cone, and wedge type packings of chemical resistant pure teflon —engineered for greater flexibility and resiliency. Full information detailed in Bulletin TP-1053.
342 U. S. Gasket Co.

Rings, O-.....Details production and application of rubber O-ring seals. Covers sections on end products, O-ring sizes, dash numbers and variable tolerances, dimensional data, etc., in 16 p. Brochure.
415D Minnesota Rubber & Gasket.

Rings, O-.....Illustrated 24 p. provides valuable information on company facilities and product line. Includes service recommendations, dimensional data for the installation of O-rings, O-ring test reports, etc.
415E Stillman Rubber Co.

Rings, Packing.....Announces creation of new department for molding & machining of packing rings & other small parts from pure Teflon, Teflon combined with other ingredients, shredded lead, etc. Bulletin 77.
415F Flexrock Co.

Rings, Weldless Rolled.....New Folder explains 8 ways to improve product design through the use of weldless rolled rings. Describes and illustrates rings in sizes to 240 in. and weights to 40,000 pounds.
415G Ladish Co.

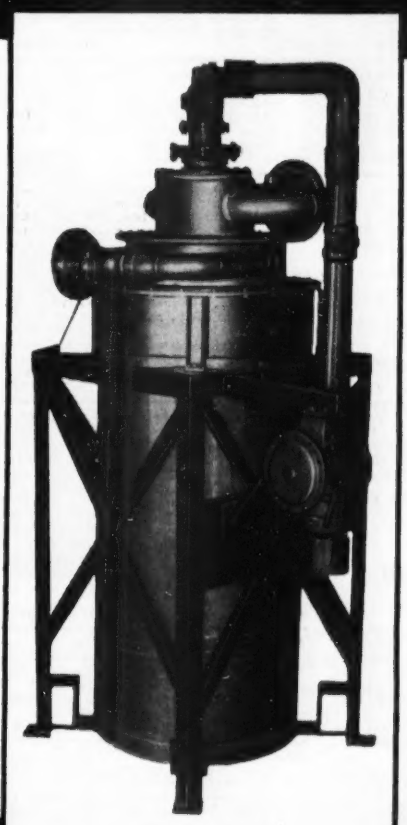
Seal Cages, Teflon.....For lubricating or cooling stuffing box packing. Able to withstand contact with acids, organic solvents, thionyl chloride, etc.—at normal & elevator temperatures. Data in Packing & Gasket Catalog.
319 Chemical & Power Products.

Seals, Mechanical.....For oil refinery process pumps. Offer numerous advantages: extreme simplicity; low cost; great sturdiness; universally adaptable. Complete details on features in illustrated Bulletin No. 9.
415H Sealol Corp.

COMPACT SOURCE OF
HIGH PRESSURE HOT AIR OR GAS

THERMAL'S TYPE DF HEAT EXCHANGER

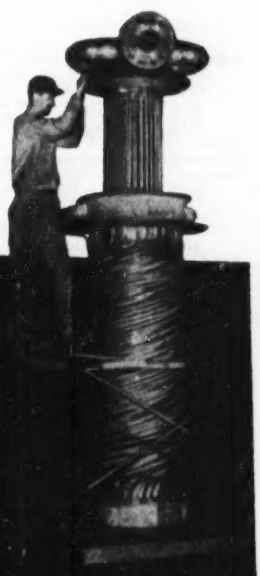
PRESSURES TO 300 PSIG
TEMPERATURES TO 1200 F



Higher temperature units available

Modernize your processing techniques . . .

Rapid heat-up and response characteristics make the THERMAL DF Heat Exchanger particularly valuable where wide load changes and operating levels must be met quickly. The minimum amount of refractory used makes convection heat transfer predominant.



STRESS FREE DESIGN

Two pass counterflow construction is used with one pass being coiled to eliminate need for expansion joints. A THERMAL high velocity burner for gas, oil or combination is an integral part of the unit. Construction is all welded and of highest grade stainless steels.

WRITE FOR BULLETIN 105

OTHER THERMAL PRODUCTS & SERVICES . . . GAS & OIL BURNERS
• COMBINATION GAS-OIL BURNERS • HEAT EXCHANGERS • AIR HEATERS
• SUBMERGED COMBUSTION • COMBUSTION & HEAT TRANSFER ENGINEERING

THERMAL
Thermal Research & Engineering Corp.
CONSHOHOCKEN • PENNSYLVANIA
REPRESENTATIVES IN PRINCIPAL CITIES

Sprockets.....Describes newly expanded line of Taper-Lock stock sprockets. Sizes and prices for ½, ⅝, ¾, 1, 1¼, 1½ and 2-in. pitch Type B stock sprockets with a hub on one side. Catalog C56-54.
416A Morse Chain Co.

Sprockets.....Covers latest technical data and prices on all items in newly extended line which includes sprockets and chain for sizes ranging from 40 thru 160. Pitch range is from ½" thru 2". 4 p. Bulletin A-632.
416B Dodge Mfg. Corp.

Teflon Products.....Illustrated booklet, "The Best in Teflon," covers data on teflon parts and products—bellows, bellows connectors, pump and valve packings, tubing and other molded forms. 12 p. Chemlon Catalog.
339 Crane Packing Co.

Turbines.....Simple, rugged turbine for mechanical drive operates under all inlet steam conditions up to 600 psig and 750 F. Modified construction allows maximum inlet temperature of 825 F. Bulletin 4202.
416C De Laval Steam Turbine Co.

Turbines.....Mechanical drive turbines offer cost-saving features: combined trip-throttle valve; interchangeable parts; single reservoir for cooling lube oil; etc. Contains pertinent details in Bulletin GEA-4955A.
259-1 General Elec. Co.

Turbines, Steam.....Turbines range from 150 horsepower down to fractional in 6 frame sizes. Feature large number of manually operated valves for individual control of steam nozzles. Offers details in Bulletin 135.
81 Coppus Engrg. Corp.

Heating & Cooling

Boiler Blowoff Equipment.....Describes how automatic continuous blowoff equipment successfully meets demands of modern boilers. Offers economy of fuel, smaller quantity of blowoff, etc. Illustrated Bulletin 2391A.
416D Permutit Co.

Boilers.....Provide superior boiler performance . . . for steam or hot water 15 to 40 hp (15 to 150 lb. steam, 30 lb. water). For commercial, industrial, and institutional use. Details in illustrated Bulletin AD-134.
416E Cleaver-Brooks Co.

Boilers, Packaged.....Available for oil, gas and combination oil/gas firing. Sizes 15 to 500 hp, 15 to 250 psi—for heating and processing. Covers details and cost-saving advantages in illustrated Catalog AD-100.
45 Cleaver-Brooks Co.

Boilers, Packaged Automatic.....Covers 2 types in 17 sizes from 15 thru 500 hp for steam processing as well as steam & hot water heating service as applied to hospitals. Information in illustrated Bulletin 1223.
416F Orr & Sembower.

Burners, Piloted Entrainment.....Covers valuable information concerning features, construction, and specifications. Also included in the Bulletin are diagrams, charts and photographs. 4 p. No. H-64.
416G Eclipse Fuel Engrg. Co.

Burners, Tunnel.....For use with any complete gas/air mixture up to 10" MP. Made in 3 sizes: 4", 5" and 6" with flanged connections. Includes full description, dimensions and capacities, etc. in Bulletin H-65.
416H Eclipse Fuel Engrg. Co.

Conditioners, Air.....Describes how equipment produces precise control of air temperature & moisture enabling manufacturers to make their products in any climate & at any season, in illustrated Bulletin No. 122.
416I Niagara Blower Co.

Coolers, Air-Quenching.....Information on how savings can be effected in the cement, lime and chemical industries through use of an air-quenching shaking grate cooler. Details in illustrated Bulletin 07B7869.
39 Allis-Chalmers Mfg. Co.

Coolers, Cascade.....Corrosion-resistance prevents chemical attack inside tubes and permits the use of river or sea water as coolant. Includes heat transfer nomographs, tables, etc. in Catalog No. PE-8.
167b Corning Glass Wks.

Coolers, Water.....Descriptive Bulletin provides information on line of instant water coolers. Includes operating principle, various applications, details of construction, etc. Fully illustrated. No. 153-1.
416J Frick Co.

Exchangers, Scraped Surface.....Closed, "flow-thru," pressure type systems which permit the use of flammable, volatile and expensive solvents with greatest safety and no danger of solvent loss. Bulletin No. PE-1.
281 Henry Vogt Mach. Co.

Generators, Steam.....Offers complete details on packaged water tube steam generators . . . furnished for oil or gas firing or both, with automatic, semi-automatic or manual combustion controls, in Bulletin MH-3-54.
416K Union Iron Wks.

Heat Exchangers.....Company issues new, 24 p. descriptive Booklet on their Heat Exchanger Division. Covers the operations required in manufacture of equipment, with complete illustrations and photographs.
416L Lummus Co.

Heat Exchangers.....Nukem Hi-Temp heat exchangers are designed to provide superior service in heat transfer for practically all commercial acid, salt and alkaline solutions. Includes features and prices.
416M Nukem Products Corp.

Heaters, Air.....Simple & compact source of heat for applications where products of combustion can be mixed with the air being heated. Covers data on operation, typical sizes, applications, etc., in Bulletin 104.
416N Thermal Research & Engrg.

Heaters, Infrared.....Data on new radiant heaters which provide more than 100 watts per sq. inch of lamp surface. Covers outstanding features. Installation, applications, etc. in fully illustrated Bulletin.
4160 N. J. Thermex Co.

Heaters, Unit.....Presents descriptive literature on Grid unit heaters. Offer all cast iron construction that stands up well against corrosive acid fumes of HCl, Cl₂, etc. Full details in Catalog No. BC-1049.
168 D. J. Murray Mfg. Co.

Heating & Cooling, Multi-Tier.....Convert heating, cooling, drying & similar operations from batch to continuous processing. Process products under exact time, temperature & atmospheric control. Reduce handling. 8 p.
316 J. W. Greer Co.

Heating Units, Electric.....Makes available a new, illustrated 23 p. Booklet covering complete information on heaters, thermostats & snap switches for the users of industrial electrical units. No. B-6161.
416P Westinghouse Elec. Corp.

Mixers, Steam & Water.....For a small, localized supply of warm or hot water ...use company line of steam and water mixers. Economical, easy to install, feature numerous uses. Full details in Bulletin No. 349.
L336 Powers Regulator Co.

Platecoils.....For tank heating & cooling problems due to inefficient pipe coils. These cost-saving Platecoils heat or cool 50% faster & take 50% less space in the tank. Full data on features in Bulletin P61.
44 Tranter Mfg.

Towers, Cooling.....Company offers many years of experience in the design and manufacture of cooling towers for every type of service. Complete information in illustrated bulletin, "Cooling Water for Industry."
139 Fluor Corp.

Towers, Cooling.....Contains great deal of new material on air-conditioning cooling tower applications, specifications, selection and installation. Includes data on operating characteristics. Catalog WT & CT-583.
416Q Halstead & Mitchell.

Towers, Cooling.....Open gravity distribution is one of the exclusive design features of company's line of crossflow cooling towers. Advantages are thoroughly explained in new, 32 p. Bulletin No. CF-54.
9 Marley Co.

Traps, Steam.....Company line of steam traps offer many advantages. Feature small size, lightweight, body and all working parts of stainless steel. Low cost, low maintenance. Data in Steam Trap Bulletin.
239 Yarnall-Waring Co.

Traps, Steam.....Provides a descriptive Catalog which includes capacity tables, installation diagrams, & data, charts, & formulae for determining the proper size trap. Details in Nicholson Trap Catalog 953.
135 W. H. Nicholson & Co.

Tubes, Heat Exchanger..... Feature many valuable advantages: longer time between re-tubings; more hours of production with less downtime; lower cost per year. Complete information on tubes in Booklet CEC-54.
257 Republic Steel Corp.

Handling & Packaging

Belts, Conveyor, Woven Wire.....Help provide continuous, automatic production—automation. Impervious to damage from abrasion, corrosion, heat, or cold. Makes available valuable technical manual of belt applications.
L360 Cambridge Wire Cloth Co.

Carriers, Materials-Handling.....For high degree of materials handling efficiency. Offer many features: open-side forks; 4-wheel Radiarc steering; excellent visibility; etc. Fully illustrated, 16 p.
416R Clark Equipment Co.

Casters.....Neoprene seals on new series increase life, and cut maintenance time and expense by keeping lubricant in the raceways and sealing out destructive dirt, water and chemicals. Descriptive literature.
416S Rapids-Standard Co.

Conveyors.....Makes available a detailed 192 p. Catalog of standardized components, accessories, typical conveyor layouts and installation photographs. Complete, comprehensive, and easy-to-use. No. 76-A.
BM352 Barber-Greene Co.

Conveyors, En Masse.....Information on how an enclosed endless chain, fitted with specially designed flights, conveys such free flowing materials as grain, resins, pigments, etc. Fully detailed and illustrated.
416T Gifford-Wood Co.

Conveyors, Power.....24 p. completely describes and illustrates 3 individual belted power conveyor frame designs —channel frame, unitized formed rail frame and angle iron frame. Includes numerous cutaway views.
416U Food Machy. & Chem. Corp.

Conveyors, Screw.....Includes various sizes and types of conveyors fully illustrated with photographs, line drawings, dimensions, in detailed Screw Conveyor Catalog and Engineering Data Book ID-541.
416V Continental Gin Co.

Conveyors, Tubular.....Offers data on a totally enclosed bulk material handling conveyor featuring a 2-directional chain to convey in any direction. Provides complete information in illustrated Bulletin R-20.
417A Prab Conveyors.

Conveyors, Vibrating.....Designed for toughest materials handling jobs. Numerous advantages: less power required; longer conveyors—one drive; higher capacity; less headroom; etc. Offers Bulletin 135A.
417B Hewitt-Robins.

Drums.....Tight head or removable head types...protect sensitive chemicals, oils, and food products against contamination during shipment or in storage. Features and details in Hackney Drum and Barrel Catalog.
79 Pressed Steel Tank Co.

Feeders, Belt Gravimetric.....Simple mechanical control...wide feeding range...positive, non-flood rotor for "floodable" materials . . . accurate within 1% over range specified. Offers data in Bulletin 35-G5A.
417C Omega Mach. Co.

Feeders, Dry & Liquid.....Equipment package is complete solution to difficult feeding problems—adaptable to all types of feeding and proportioning requirements. Complete information contained in Bulletin BIF-K7.
229 Omega Mach. Co.

Feeders, Liquid.....Rotodip liquid feeders accurate within 1% by volume. Infinitely adjustable over 100 to 1 range. Adaptable for handling corrosive liquids—simple, dependable. Descriptive Bulletin 65-H12.
417D Omega Mach. Co.

Hoists, Skip.....Sequence views of operation of weigh type & plug feed loading gates, capacities of various size buckets...travelling various heights at various speeds, etc., in 16 p. illustrated Bulletin 110.
417E C. O. Bartlett & Snow Co.

Labelers, Automatic.....Company makes available important information on a high capacity automatic labeler... providing neat & uniform labeling & folling. Covers construction & specification details. Illustrated.
417F Standard-Knapp Div.

Loading Machines, Pallet.....Bulletin describes and illustrates the unique adaptability of the Series "200" machine. Photographs show it performing a number of palletizing operations. Lists general specifications.
417G Alvey Conveyor Mfg. Co.

Materials Handling, Bulk-Flo.....For reduced handling costs on a wide range of materials. Feature the ability to feed, convey, elevate in one compact, fully enclosed assembly. Full data in 28 p. Bulk-Flo Book 2475.
13 Link-Belt Co.

Materials Handling Equipment.....Offers fully illustrated 20 p. Catalog describing principal products of the Pressed Steel Division. They include steel boxes, skids, pallets, foundry flasks, stampings. Adv. 620.
417H Republic Steel Corp.

Packaging.....Describes how the company is prepared to handle research, design & testing of any type of product packaging, & carry the project thru the actual production packaging, final crating & shipping.
417I Webhart Corp.

Packaging Machines.....Describes new improved units for packaging of a wide variety of free-flowing & mixed materials not suitable for volumetric filling. Covers operation, features, design, etc., in Bulletin 4966-W.
417J Stokes & Smith Co.

Packers, Carton.....Offers data on collectors & packers for cartons, bags & cans. Includes description, summary of advantages, general packer characteristics, etc., in completely illustrated Bulletin No. 800-2.
417K Standard-Knapp Div.

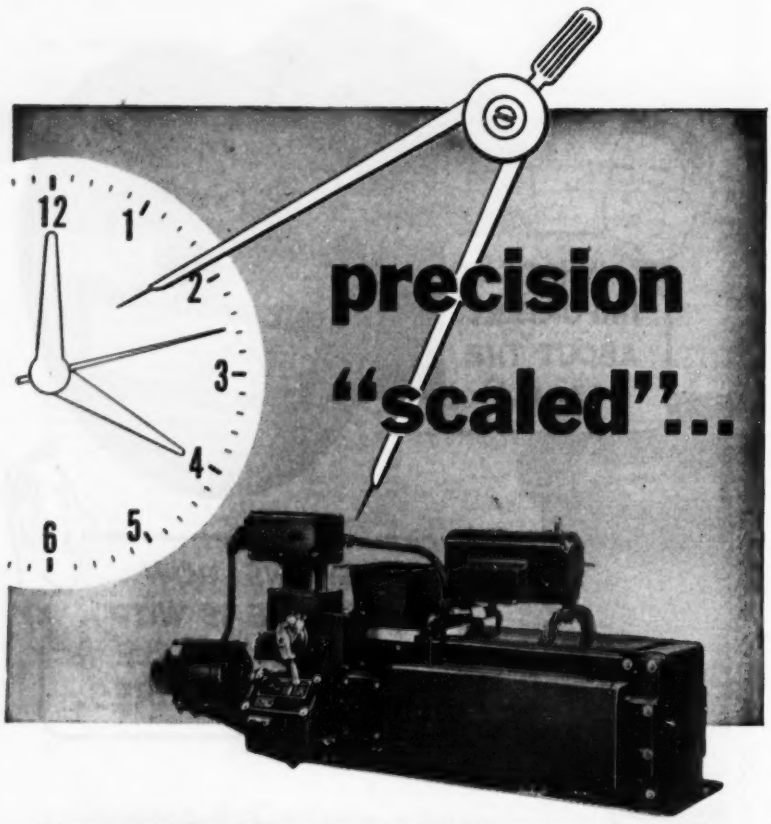
Here's how a reel of T-E wire looks after you unwrap it. The easy-to-read label can save valuable time when you must know, and know quickly, what kind of wire is on the reel. The label tells you not only wire type, length, and polarity, but insulation colors too. Therefore, you can identify conductors easily by comparing colors listed on the label with those on the wire itself.

As you can see, it's a well-thought-out label. Important by itself, it's also a revealing illustration of the care T-E takes. Thoroughness is characteristic of every step in T-E's wire production, from drawing and calibrating to insulating. The result of such care is a product which meets high industrial standards.

There are too many T-E wires to mention comfortably in one ad. However, in T-E's 8-pg. Wire Bulletin you can see insulations, gages, and calibrations, as well as charts with calibration symbols, color codes, insulation characteristics, resistances, weights, electrical properties, and conduit capacities. Write for Bulletin 31-E

Pyrometers • Thermocouples • Protection Tubes • Quick-Coupling Connectors
Thermocouple and Extension Wires • Resistance Bulbs • Connector Panels

Thermo Electric Co., Inc.
SADDLE RIVER TOWNSHIP, ROCHELLE PARK POST OFFICE, NEW JERSEY
IN CANADA—THERMO ELECTRIC (Canada) Ltd., BRAMPTON, ONTARIO



FOR MINUTE TO MINUTE ACCURACY

Minute to minute accuracy in the feeding of dry materials — uniform delivery to reaction tanks, continuous blending, or batch mixing — is a requisite for maintaining uniformly high quality in final products, in modern chemical processing operations.

W & T Merchen Scale Feeders which weigh and feed in one operation ensure this exacting accuracy. Precision "scaled", durably constructed and simply controlled, the Feeder weighs all material and immediately compensates by weight for variations in density, moisture content, etc. Whether feeding ounces or pounds per hour, the pre-set rate of feed is continually and automatically maintained.

If you have a processing problem requiring uniform feeding of dry materials, accurately controlled by weight, communicate with Wallace & Tiernan. You'll receive prompt attention without obligation.

M-21

WALLACE & TIERNAN
COMPANY, INC.
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

LITERATURE . . .

Phenol Handling.....32 p. Booklet covers complete information on unloading tank cars, unloading small containers, sampling, storing, transferring, etc. Complete with charts, graphs, illustrations, etc.
14-5e Monsanto Chem. Co.

Platforms, Custom Work.....Illustrated Folder covers all-steel portable and stationary platforms custom-fitted to each work requirement. Usage results in increased production, safety, and convenience.
418A Ballymore Co.

Space Wheels, Fork Truck.....Show aisle width required for right-angle stacking with all types of fork trucks, area devoted to aisles in square ft., & savings made possible in cubic ft. of storage space. Illustrated.
418B Lewis-Shepard Products.

Stackers.....Describes in detail new electro-hydraulic platform & straddle stackers. Completely illustrated... contains specifications & data on these lightweight power-lift units. Handy Holster Circular 28A.
418C Lewis-Shepard Products.

Tank-Trailers.....For the fast movement of raw materials in full or partial loads, wherever & whenever needed, eliminating costly delay, reducing need for expensive inventories of supplies, etc. Illustrated.
123 Fruehauf Trailer Co.

Tractor-Loaders.....Describes a rubber-tire tractor-loader with a standard bucket capacity of 12 cu. ft. Designed for the economical handling of bulk chemicals, sand, dry materials, castings, scrap, etc.
418D Baker-Lull Corp.

Tractor-Loaders.....Feature the numerous advantages of loading with the combination of specially designed clutch-type transmission & smooth-operating hydraulic torque converter. Provides detailed literature.
101 Tractomotive Corp.

Tractor-Shovels.....Company line handles big quantities of materials—loose, solid, packaged or unpackaged. Have the power, weight, and traction to work anywhere without bogging down. Literature offers full data.
264-5a Allis-Chalmers Mfg. Co.

Tractor - Shovels.....Offer superior bucket action...handle bigger loads, move more yardage—faster, at considerably lower cost. Includes data on torque converter, specifications, action photographs, etc., in Fact-Folio.
49 Clark Equipment Co.

Tractors, Gasoline.....Describes and illustrates standard model (2,400 lb. draw bar pull rating) and heavy-duty model (3,000 lb. draw bar pull rating). Data on features and performance. Bulletins T-101, T-102.
418E Mercury Mfg. Co.

Truck Operation, Fork.....Makes available informative reprint, "Proper Operator Judgment Cuts Cost of Fork Truck Operations." Literature proves extremely valuable to any firm which makes use of fork trucks.
418F Mercury Mfg. Co.

Truck Operation, Industrial.....Do's and don'ts of safe operation of industrial trucks are detailed in new available literature—31 rules for effective, safe operation of trucks are pictured and/or discussed.
418G Elwell Elec. Co.

Trucks, Fork.....Provides information on the new Safety Silhouette electric fork trucks...designed prmiarily for operating in close quarters. Covers features, dimensions, specifications, etc. Illustrated Bulletin 5001.
418H Yale & Towne Mfg. Co.

Trucks, Industrial.....Company provides valuable data on application of specially-designed industrial trucks ...for handling of unusual loads, to solve difficult operation conditions, increase plant safety, etc.
418I Elwell-Parker Elec. Co.

Trucks, Lift.....Describes & illustrates unique side-loading lift trucks designed to handle long, bulky loads. Includes data on features, applications & attachments, dimensions & specifications. Bulletin 1360.
419A Baker-Rauling Co.

Processes, Services, Misc.

Autopositive Paper.....Company presents illustrated booklet, "Modern drawing and Document Reproduction," offering valuable information on the line of Kodagraph materials. Covers cost-saving features.
68 Eastman Kodak Co.

Demineralization, Mixed-Bed.....Covers the numerous advantages of mixed-bed demineralization. Provides a complete operating description of process. Data in fully detailed and illustrated Bulletin 3983.
419B Permutit Co.

Design & Construction.....Major contractor for the design, engineering and construction of one of the world's largest petro-chemical plants. Data in 24 p. illustrated booklet, "Industry's Partner for Progress."
419C J. F. Pritchard & Co.

Face Shields.....New face shield series features a deep spark deflector that blocks foreign particles from entering at top of face shield. Details on this and other valuable safety advances in new Brochure S-2141.
58 American Optical Co.

Filter Aids.....Chemically inert, sterilized in processing & suitable for filtering all types of liquids from acids to zein. Used in processing many products—beverages, foods, metals, oils, etc. Bulletin B-12.
154 Dicalite Div.

Goggles, Visor.....Provide right combination of protection from industrial eye hazards: protection from flying particles and splashes, and protection from glare. Features and details in new Bulletin 0301-3.
419D Mine Safety Appliances Co.

Gravity Concentration.....New literature describes how tables are used to treat materials subject to gravity concentration. Includes data on capacity, operation, construction, application, etc. Bulletin T1-B3.
419E Denver Equipment Co.

Models, Scale.....Presents informative Brochure describing ten functions of scale models. Covers data on design, check, training, erection, time study & safety standards, future planning, etc. Illustrated.
419F Project Models Co.

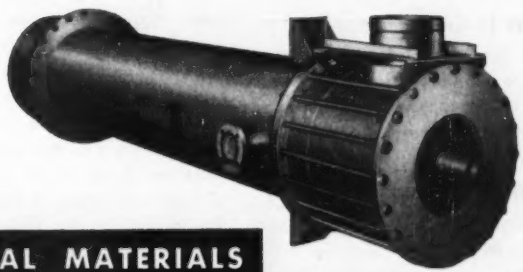
Protection Guide, Gases.....Offers protection guide for hazardous gases. Lists 433 gases, fumes, mists and dusts present in operations where a gas mask should be worn...and canister for each hazard.
419G Acme Protection Equipment.

Solvent Safety.....The problem of finding the right solvent for jobs that must be done is shown to be capable of easy analysis & sure control by application of seven rules of measurement to solvent qualities.
419H John B. Moore Corp.

Waste Treatment, Industrial.....Describes advantages inherent in the treatment of industrial waste waters and process liquors. Includes details, schematic drawings, photographs, etc., in 4 p. Bulletin No. WC-116.
419I Graver Water Conditioning.

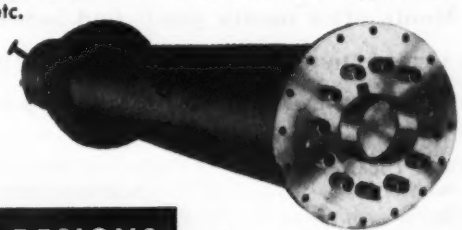
Water Conditioning.....Comprehensive Data Book covers numerous subjects: hydraulics; impurities in water; chemical conversions; coagulant, acid & alkali dosages; chemicals used in water treatment etc. No. 2478A.
419J Permutit Co.

THE ANSWER TO YOUR EXCHANGER PROBLEM MAY BE HERE



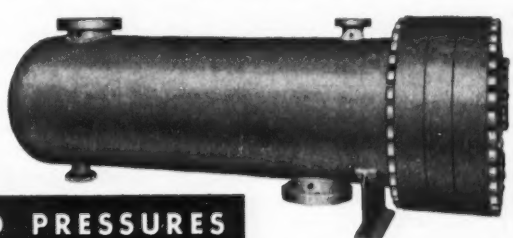
SPECIAL MATERIALS

If your requirements call for special materials of construction, Whitlock can help you. Here's just one example — a graphite tube side, steel shell side exchanger. This exchanger utilizes chemically inactive graphite which has been resin impregnated. Units of this type are particularly adapted to process operations where highly corrosive fluids must be handled. We also regularly work with other anti-corrosive materials: stainless steel, copper, nickel, Monel, Hastelloy, etc.



SPECIAL DESIGNS

Perhaps you need special design techniques — if you do Whitlock can help you. For example, this falling film evaporator (with top channel removed) was carefully designed with a maximum elevation difference in tube ends of plus or minus 0.005" to assure proper feed distribution to individual tubes. Whitlock Engineers are thoroughly experienced in designing exchangers for difficult operating conditions.



ELEVATED PRESSURES

Perhaps you need an exchanger for elevated pressures like this rugged cooler, built for design pressures of 600 p.s.i.g. on both shell and tube sides. Its "Monobloc" (solid disc) channel is about 7" thick to take care of the working pressure. The 1" thick shell was stress-relieved after fabrication. We are regularly manufacturing shell and tube units (for pressures to 3000 p.s.i.g.) and shell and coil units (for pressures in excess of 5000 p.s.i.g.).

Whitlock

For recommendations write The Whitlock Manufacturing Company, 94 South Street, West Hartford 10, Conn.

Designers and builders of bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

Your Index to Advertisers in This Issue

What It Contains . . .

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You can use this index to spot quickly what advertisers are in this issue and the page location of their ads. You can get more information on the products advertised by any of these companies by circling the page number (code) on the Reader Service postcard inside the back cover. When more than one product is advertised, refer to the alphabetical listing in the Index to Chemicals and Equipment for the code number of the specific product in which you're interested.

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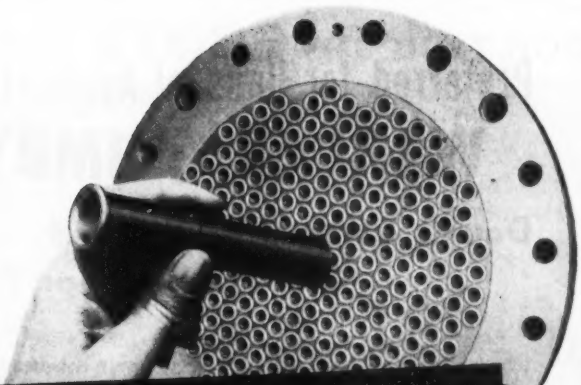

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You save man-hours and money with new Wilson Condenser Tube Inserts because they eliminate the need to plug off leaking condenser or heat exchanger tubes. Wilson Inserts go in fast . . . need no cementing . . . take less time than it does to plug a "bad tube". What's more, these highly efficient inserts put the tube back into operation as in the original design.

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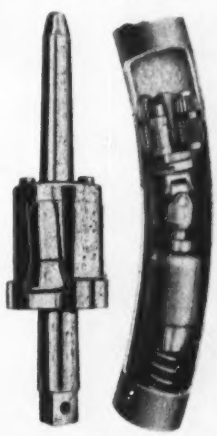
For re-rolling old tubes or installing new ones. Precision-made to insure firm seating. Self-feeding and parallel expansion for a particular trade.



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Warren-Quimby Hopper Type Pumps are available in stainless steels, acid bronze, nickel and any other machinable metal, in addition to regular cast irons and steels, and with or without body jacketing.

Warren-Quimby No. 4 Hopper Type Pumps
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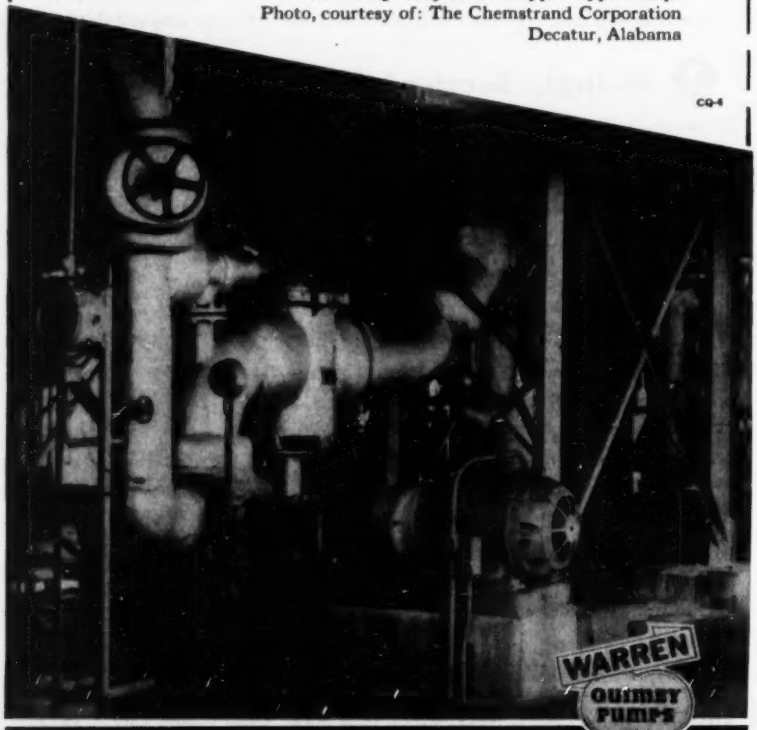

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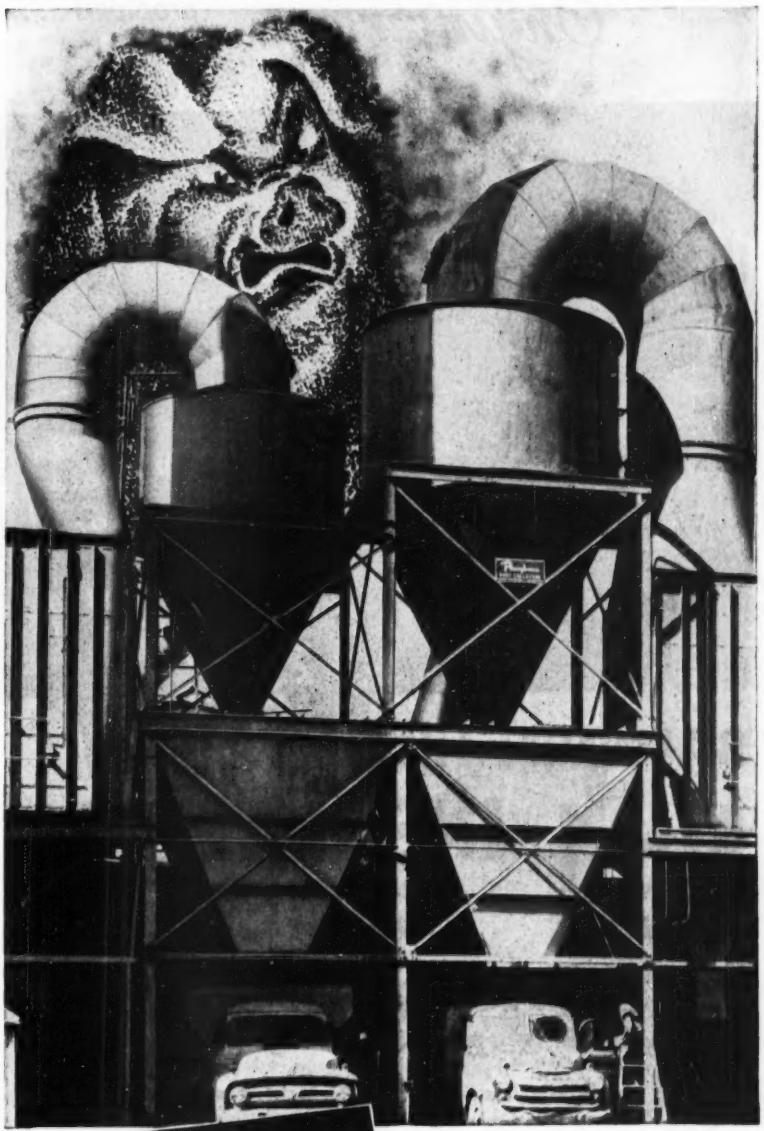

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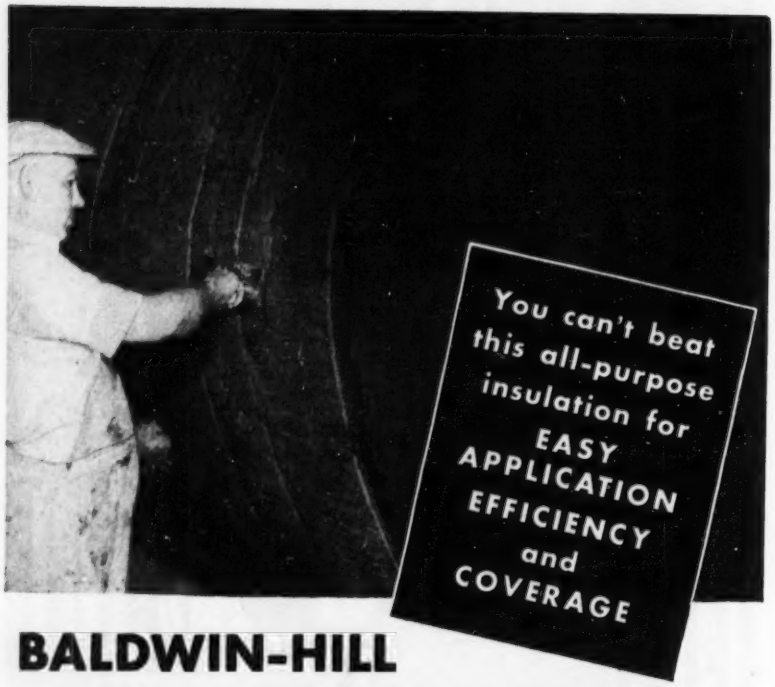

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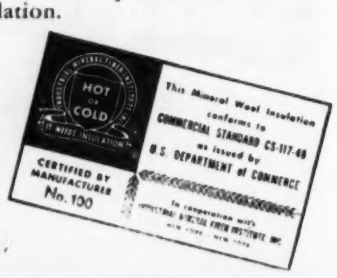

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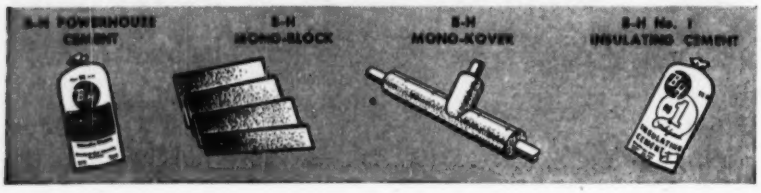

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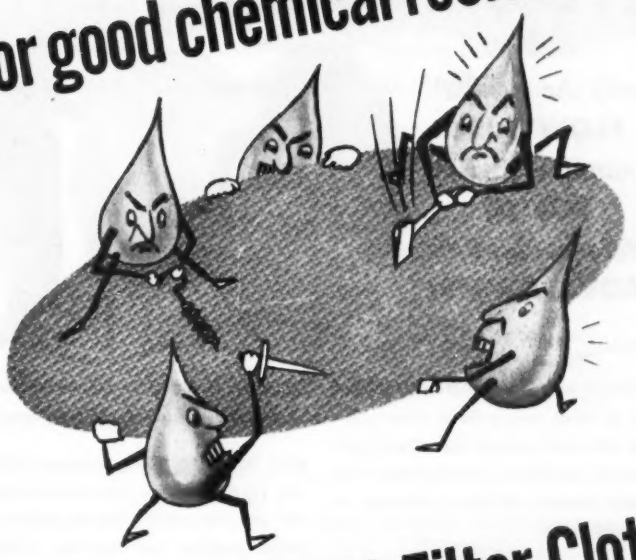

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Most common alkalies	Alcohols
Most organic acids	Carbon Bisulphide
Halogenated hydrocarbons	Carbon Tetrachloride
Aldehydes	Trichloroethylene
Ketones	Benzene

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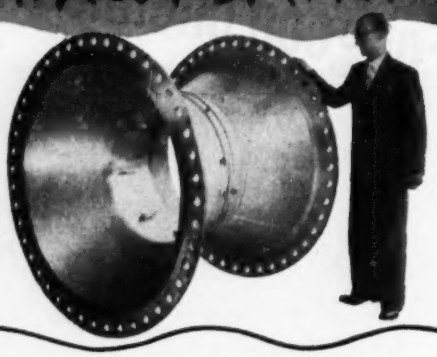

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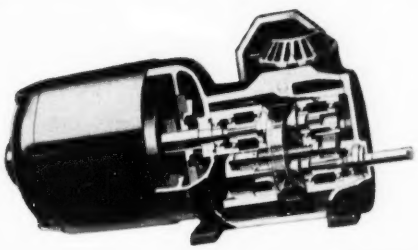

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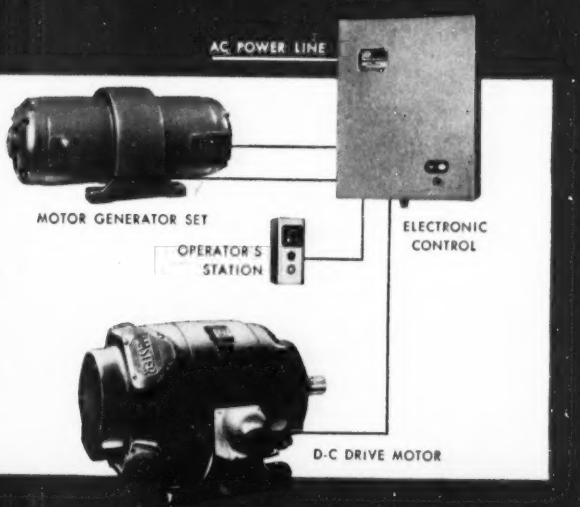

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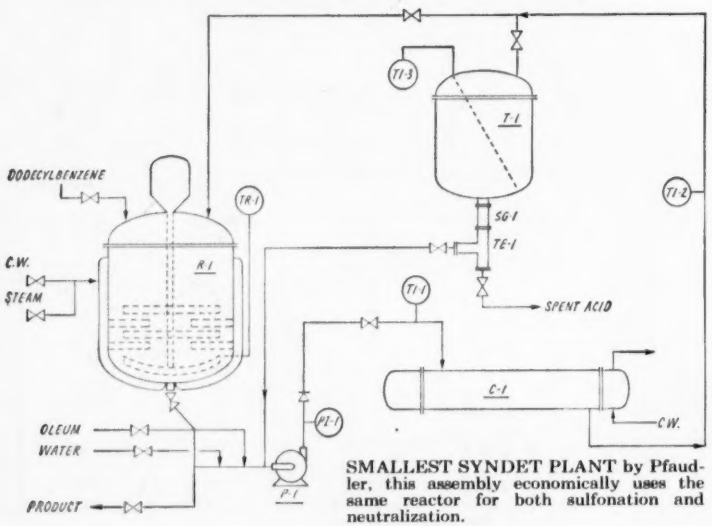

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To meet the growing demand for a small-scale alkyl aryl detergent plant, Pfaudler now offers a complete pilot plant, priced less than $8,000.

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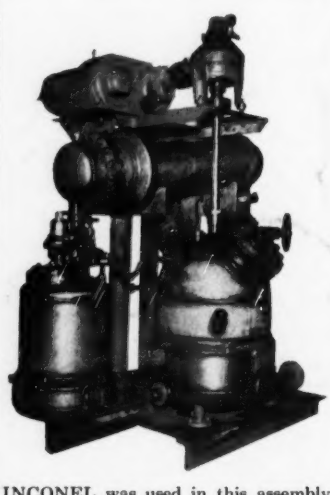
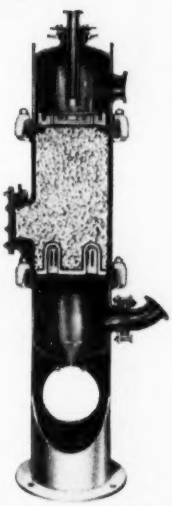
All items are glassed or stainless steel. This system will produce up to 400 lbs. of finished detergent slurry in an 8-10 hour day. With the addition of a second reactor, semi-works production is possible, producing about 2,000 lbs. of high active detergent slurry in a 24-hour operating day.

Many plants are now saving money by producing their own detergent. Perhaps this low-cost "all-in-one" plant is the most convenient way for you to begin this practice. Write us today for further details.



INCONEL was used in this assembly for solvent recovery. See article (right).

First Column Ever To Have a Family!



They said it couldn't be done. They said every glassed steel column had to be a custom job, built to meet the customer's special requirements.

But Pfaudler wondered about that. Wondered why all these "special" features couldn't be included as standard. Wondered if a standard design wouldn't cut the cost, speed the delivery, increase the flexibility of Pfaudler glassed steel columns.

Out of all this pondering came the new *standard* family of glassed steel columns, first in the world. From the 2-inch (diameter) "baby" column to the 48-inch "grandaddy" tower, in any desired length, you can now expect fast delivery, and the flexibility of standardized components. Yet you still get the corrosion resistance and working strength of glassed steel!

For more information about *standard* glassed steel columns, write us today.

Super Market for Chemical Equipment

Vast choice of materials gives corrosioneers a free hand in solving your process problem.

Besides stainless steel and glassed steel, Pfaudler corrosioneers have a complete selection of alloys to use in solving process equipment problems.

Hastelloy, monel, nickel, inconel, aluminum, titanium—through experience with hundreds of corrosion applications, Pfaudler knows just which alloy will best suit each situation. You can be sure of exactly the material of construction that will do the job best, because Pfaudler has no "favorite sons."

If you've a process equipment problem involving corrosion, contact your Pfaudler representative for an unbiased analysis of your needs or drop us a line today.